AMMJ

January 2014 Issue

Asset Management & Maintenance Journal

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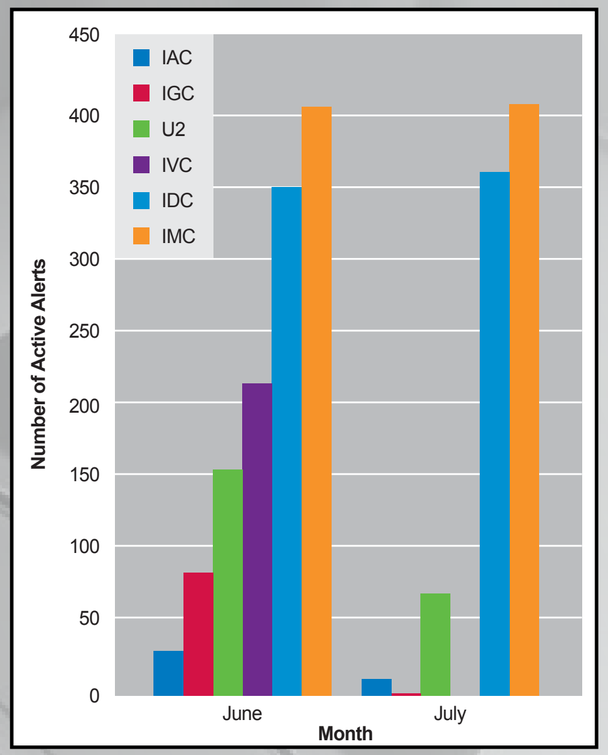

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Petrochemical Complex Ratchets Up Reliability

Multipronged initiative leads to substantially improved asset performance

Majed Al-Rassi,
Saudi International Petrochemical Co. (Sipchem)

Staff at many chemical plants spend most of their time "fighting fires" to keep units operational. Therefore, they can't give adequate attention to finding ways to prevent unexpected failures that can incur costly downtime and damage — and pose potential risks to personnel.

Such was the case at the Saudi International Petrochemical Co. (Sipchem) complex at Jubail, Saudi Arabia, where asset availability and uptime remained below targeted levels for relatively new plants. Management was frustrated with the difficulty in achieving the high level of performance needed to compete in world markets.

Established in 1999, Sipchem began producing methanol, butandiol and tetrahydrofuran in Jubail in 2004; the Acetyls Complex started making acetic acid and acetic anhydride in 2009. Downstream products now include ethylene vinyl acetate, low-density polyethylene, ethyl acetate and butyl acetate.

During the early years, plant trips were too frequent, and plant personnel only could react to process disruptions. Even with thousands of smart field devices generating ever-increasing volumes of data on the condition of critical production assets, no effective method was in use to apply that information to prevent unexpected equipment failures. In addition, personnel had no good way of knowing whether routine maintenance was being done too frequently or not often enough.

Nor could they easily identify the "bad actors" - those few machines and field devices that cause the most problems.

There were plenty of questions including:

- How can maintenance practices be changed to produce better results?
- What equipment fails most often and what's behind that failure frequency?
- Which assets represent the greatest risk to availability?
- Are maintenance dollars being spent properly to achieve high reliability?

Getting Answers

Sipchem turned to a reputed Process Management's Asset Optimization Services company to help improve plant performance. In the last four years, it has performed reliability-centered maintenance (RCM) on all existing production units at Jubail, covering approximately 20,000 assets.

This work, which began in the Acetyls Complex, involved validating information that already had been entered into a SAP computerized maintenance management system (CMMS) and including many more assets, some of which were purposely omitted from SAP when the plant was built. Also, it addressed a serious deficiency in the way assets were described — using general terminology rather than tag numbers. That created a real problem for the maintenance organization because there was no way of tracking many of the maintenance procedures, and no idea where maintenance dollars were being spent.

In the end, some 5,000 assets listed in the Integraph Intools software that was used in designing and starting up the complex were properly identified and transitioned into the CMMS. Asset ranking criteria were developed initially as a part of the RCM process. Every asset was ranked according to its importance in maintaining product throughput, quality, safety and environmental compliance. Among the highest-ranking assets were the reactor area uninterruptible-power-supply distribution panel, the blowdown-drum pump motor, crude pump motors, and a flash column sidedraw pump.

Those high-priority assets now receive immediate maintenance when necessary, while those of less importance get attention commensurate with their criticality ranking. With all these assets now in the CMMS, we can provide more-effective maintenance for the entire Acetyls Complex. This is the essence of RCM. At the same time, we now keep and continually update a very complete record of all maintenance activities.

Improving Diagnostics

Most field instrumentation at Sipchem incorporate predictive intelligence; our new maintenance program takes advantage of the diagnostic information derived from those smart field devices. This has involved implementing AMS Suite predictive maintenance software, which was initially installed on site but not fully utilized. The software provides easy access to the field-generated data via the DeltaV digital automation system. In this way, maintenance and control-room personnel can obtain real-time performance information from any specific smart transmitter or control valve at any time.

The software continually monitors the online devices and raises a status alert when the performance of any device, or the equipment to which it is mounted, falls below a prescribed norm. Maintenance and reliability managers can evaluate the situation to decide whether to address it immediately or wait until the next scheduled shutdown.

Knowledge is the key for the predictive maintenance strategy under which our plants operate today. Our managers now can make informed and timely maintenance decisions, improving reliability and increasing plant availability.

Predictive maintenance has proven to be less expensive over the long run than preventive maintenance and far less costly than reactive maintenance, where personnel rush to remedy unexpected equipment failures with no long-term strategy.

Figure 1 shows that comparative maintenance costs for three different plants at the complex significantly decreased from 2010 to 2011.

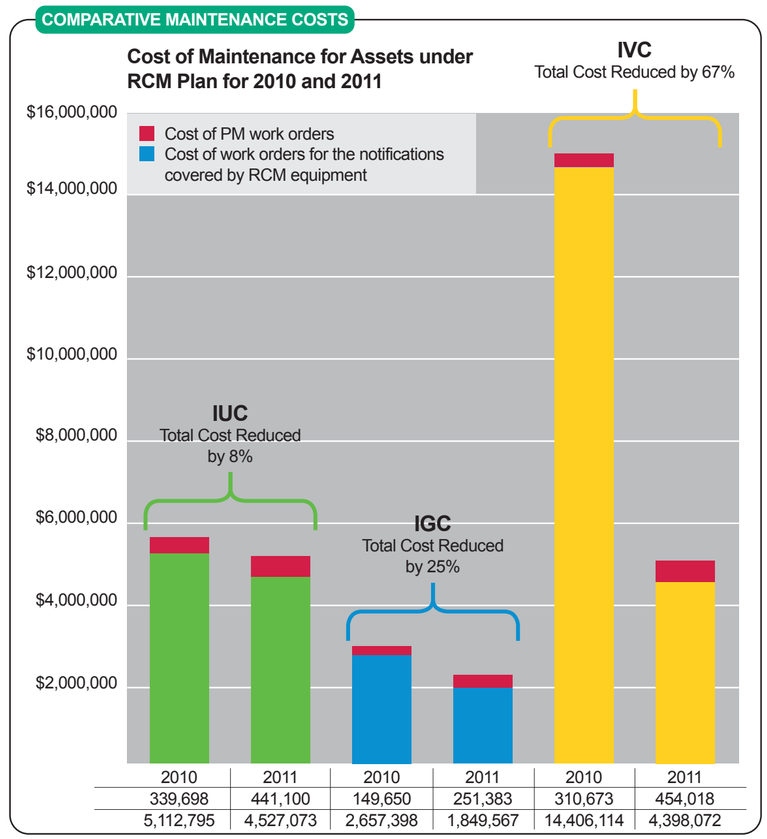


Figure 1. RCM approach led to marked reduction in maintenance costs at three plants in Jubail complex.

Assessing Asset Performance

To give management a better understanding (plus documentation) of what's happening in production units, Sipchem chose to implement AMS Suite: Asset Performance Management (APM), built on Meridium's APM software. This application can process the huge volumes of field-based information being collected and automates the flow of data from the field to our business network.

AMS Suite APM integrates predictive intelligence with asset reliability information and delivers accurate data to the CMMS. This enables creation of precise maintenance orders based on the criticality ranking of the assets, giving us a powerful tool to improve the performance of the equipment that is most important to plant reliability.

The software can be customized for each user. It features a device dashboard that provides an immediate view of asset performance, availability and maintenance in each plant. It also displays historical charts that show monthly results for overall equipment effectiveness, availability and maintenance costs. Designed for easy navigation, this system allows users to obtain greater detail on any of these factors.

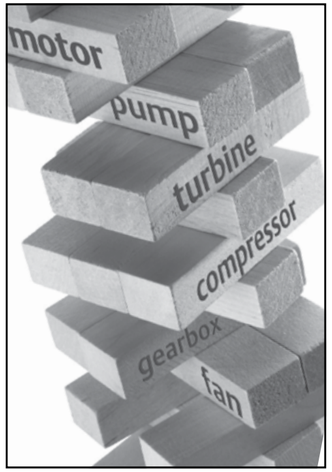
Without a doubt, asset ranking helps us shine the reliability spotlight on assets that need our attention from both the operational and maintenance perspectives. Failures are tracked, so the bad actors that account for so much maintenance time and expense can be spotted and replaced. Some of the frequently failing assets we were able to pinpoint included a carbon dioxide compressor seal, catalyst recycle pumps, high-pressure methanol feed pumps and high-pressure reactor feed pumps.

We also identified some of those elusive "performance gaps" that often cause process plants to "typically operate 20% below full production capacity," according to the ARC Advisory Group - see: www.arcweb.com, "Emerson and Meridium Partner to Resolve the Asset Performance Management Puzzle." One that we discovered and subsequently corrected involved tar receiver pumps.

Impressive Results

We have achieved a number of important benefits:

- Predictive maintenance helps us prevent unexpected shutdowns and allows us to repair or replace poorly performing assets during the next scheduled maintenance period.



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- We use the asset ranking criteria developed by our joint reliability team in virtually every facet of reliability improvement.
- Sipchem reliability personnel can quickly access information from multiple plants and view reports in near real-time.
- We have improved maintenance by creating & using key performance indicators to measure, track and evaluate the performance of each plant.
- Identifying and replacing bad actors has dramatically enhanced maintenance and reliability.
- We have substantially reduced active alerts.

Figure 2 shows that active alerts essentially were eliminated in six different production units during the summer of 2012 after implementation of AMS Suite APM in June.

Real-time analytics and reporting of overall plant health provide management with answers to many questions regarding production assets in complex systems. Repetitive tasks are eliminated, recurring problems are identified and corrected, reactive maintenance is a thing of the past, and operating practices are improved.

The Sipchem Jubail Complex now has the foundation to be a world-class chemical production facility.

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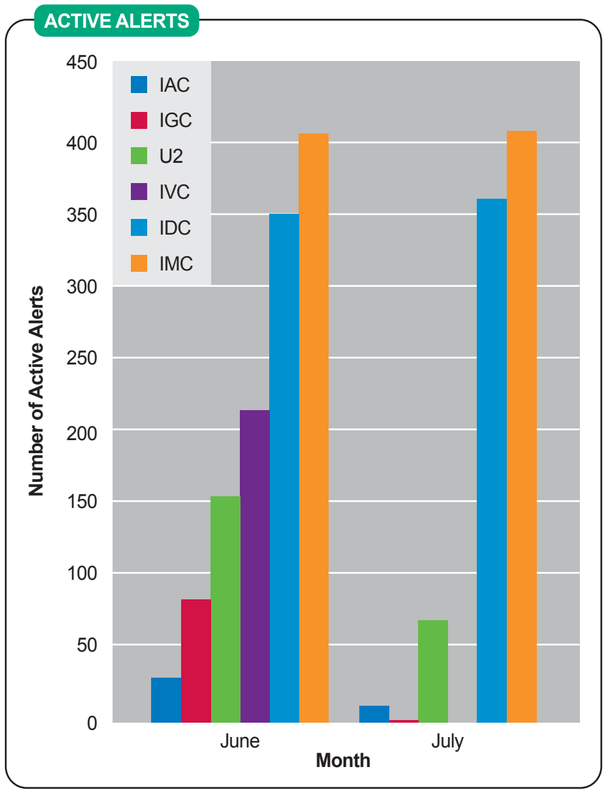

Figure 2. After asset management software was installed in June 2012, the volume of active alerts dropped significantly.

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Simplify Work Order Priorities:

Low Tech, High Value

Richard (Doc) Palmer
Richard Palmer and Associates USA

This Is the 4th In A Series of Articles From Doc Palmer

The work order priority system often goes unnoticed as a significant opportunity for boosting maintenance performance. We focus our attention on big initiatives and technology and few if any vendors try to sell us a new priority system. Restructuring the priority system requires no technology or cost. Yet, this system is one of those little things that can really help or really hinder progress toward maintenance excellence. It is a "low tech and high value" tool for improvement.

The Need for Priorities

The need to manage maintenance actively is nothing new. John Day of Alumax (Day 1993) points out that in order of preference, persons would much rather work on what they enjoy, what they are good at, or what they think is important, before what is actually important.

Dr. W. Edwards Deming (Deming 2009) states in his Point 11 that management must implement "aids and helpful leadership." The priority system provides an invaluable aid.

Nevertheless, we must see the priority system in context. Priority issues usually go away altogether when facilities begin a solid weekly scheduling effort because crews noticeably complete more work. Entire backlogs usually disappear when a scheduling effort first takes off. Therefore, the purpose of the priority system is to drive scheduling. Sometimes we forget this obvious concept. Let us discuss priorities in the context of coordinating maintenance work with scheduling.

The result of poor coordination is less than optimum plant performance and maintenance productivity at only 35% (as measured by wrench time) with much work that could improve plant performance uncompleted (whether identified in the backlog or not). The prevailing maintenance culture is "Our job is to take care of operations & backlog is fill-in work."

Yet what we want is world-class plant performance in part driven by a productive maintenance force whose culture is "Our job is to take care of the backlog which will take care of operations. Urgent calls from operations means that we did not do our job."

The plant needs a valid priority system to help maintenance schedule the right work and with minimal interruptions. This priority system coordinates selecting the proper work out of the backlog for the weekly schedule as a goal to promote productive maintenance work completion.

This priority system also coordinates operations and maintenance in properly selecting new work that should rightfully bypass the backlog and interrupt this week's schedule.

Complexity of Priorities

The priority system may be either too simple or too complex. An overly simplistic system would have three or fewer choices. Many plants only have three levels. Regardless of the formal descriptions, having only three choices means "Do it now," "Do it tomorrow," or "It will never get done" in the minds of the requestors. A limited selection is the genesis of the maintenance culture that "Our job is to take care of operations and backlog is fill-in work." The morning meeting drives the maintenance work for that day. Nearly all the new work orders are level two. We need five levels to drive the planning and scheduling process. (More levels than five are okay because they extend the use of the full five. In other words, even if no one ever picks a 10, more persons pick a 4 or 5.)

Many other plants think they have more than three choices, but in reality also have only three. Consider these commonly used choices: Safety, Emergency, Urgent, PM, Routine, Outage. This system appears to have six choices, but PM is not a priority; it is a Work Type. Outage is not a priority either; it is a Unit Condition. Furthermore, Safety is not a priority either, it is a special consideration we might call Priority Type. Obviously, not all safety concerns have the same urgency. Be careful blending in areas of concern (such as Safety, Environmental, Availability, Efficiency, and Legal, to name a few) which should be separate issues or fields for sorting. Thus, a seemingly more sophisticated priority system of six choices may only have three in practice. This is too simple.

On the other hand, priority systems can become too complex. We just cannot seem to keep ourselves from overcomplicating something if we get the chance. The primary culprit seems to be adding other inappropriate codes as discussed above, but to an extreme of having 15 or more choices. Even without inappropriate codes, adjectives seem to multiply describing a multitude of different scenarios for various equivalent senses of urgency. Some plants that use a time-based system also split fine hairs with choices of 1, 2, and 3 days; 1, 2, and 3 weeks; and 1, 2, and 3 or more months, etc. There is nothing wrong with using either an adjective or time-based system (or some combination of the two), but the system should facilitate communication. In addition, some of the adjectives should contain at least an expectation of time. There seems to be a swinging pendulum within each plant favoring adjectives and then time as time goes along. Even with appropriate adjectives or times, systems with too many choices encourage users to avoid reading and simply choose a more urgent level fearing that maintenance will never complete other work. Furthermore, it is very difficult to reason why a work order would require, say, a priority of 2 months instead of 1 month. In addition, beware of "aging" strategies where over time a work order's priority rises.

A squeaky door will never be more important than a boiler feed pump no matter how long the door has been squeaking. (Furthermore, the improved productivity in weekly scheduling makes aging a moot point.)

Another potentially complicated system is a RIME type system. These type systems take some of the responsibility for making the decision away from the user by factoring in some of the plant's predetermined knowledge of asset criticality, work type importance, or other factors. RIME is the Ranking Index of Maintenance Expenditures originated by Ramond Associates in Chicago in the early 1980s (Peters 2006). Many CMMS's automatically provide such a calculated priority. A RIME type system might multiply the predetermined asset criticality (1-10 with 10 being the highest) by the work type criticality (1-10 with 10 being the highest). Two issues with this system might be the possibility of overlooking safety. A safety work order involving potential death on a non-critical asset might score only a 10 (1 x 10) while a PM on a supercritical piece of production equipment might score a 20 (10 x 2). Simple communication also breaks down with complicated priorities. It is more difficult to explain why one person's work order only scored a 10 while someone else's scored a 20.

With this in mind, an effective system should have at least 5 levels (but fewer than 10) with a straightforward (non-multiplied) structure. There seems to be a tradeoff between the science of better determining the "true" relative priority of work using more complicated systems and the ease of discussing the relative priority using simpler systems. Priority systems should also contain at least an expectation of time. Consider the following as a decent system: 0-Start now. 1-Complete in two days. 2-Complete in two weeks. 3-Complete in a month. 4-Takes longer than a month. Including a few descriptive words helps, but do not overly confuse the levels with areas of concern (such as Safety) without qualifiers. The 5-level system offers enough choices to encourage selection beyond this week, but few enough to promote easy discussion. The requester should select the initial priority because requestor sees the problem and knows how fast it is leaking. However, because the requestor might not have a feel for the big picture of other work in the backlog, the plant should allow persons to challenge the priority later. Managers and supervisors in a short morning meeting can scan and easily discuss new work orders saying, "This is not a 2, it ought to be a 4."

Managing with Priorities

The plant uses a simple system to manage coordination. In the example 5-level system, Priority 0s and 1s are defects to be driven out by management. The need for maintenance was not discovered in time to plan and schedule the work. Management develops Pareto charts to see the most common causes of the defects whether they be from engineering (not replacing

troublesome equipment), operations (not operating correctly), maintenance (not fixing things to last), or management itself (allowing abuse of the priority system).

Some tips for using a 5-level priority system include considering work with the same priority and PMs as well as some other ideas to make the priority system more acceptable. Making the priority system acceptable for use coincides with making the weekly schedule acceptable (our overall context to begin with). Among equal priorities, schedule either oldest work orders first or largest work orders first. (The first way helps consider the aging issue better.) The exception is that PM's always come first of equal priority work orders. Maintenance PM's generally should have at least two weeks to complete which allows for better placement in the weekly schedule. (This preference places a burden on operations do any weekly or daily PM's.) Weekly schedules should follow the priority system but should include less urgent work orders for common lockouts. It is also okay to have production, maintenance supervisor, and manager input into the weekly schedule simply based on preferences. Nevertheless, schedule 100% of labor hours available and do not rest with only the preferred jobs. Encourage the use of priorities greater than 0 or 1, but do not prohibit their use. The work is what it is. Later, during execution of the weekly schedule, inform everyone that it is perfectly acceptable to break the schedule, but any work breaking the schedule should be a 0 or a 1. Management must later analyze the 0s and 1s and relentlessly manage them.

Concerning planning, planners should plan work orders within half the time allowed to complete them. For example, they should plan a Priority 1 within one day (in our example system). Nevertheless, never insist that a crew must wait on planning or scheduling to work any job. The weekly schedule only succeeds in improving productivity when the plant allows crews to break the schedule. This seems contradictory but productivity rises even when not fully meeting the weekly schedule. We meet success in improved productivity, not in perfect schedules, plans, or even priorities. We are not just trying to complete the right work with the priority system, but more of the right work.

Conclusion

With this said, many plants that have extensive complaints about their existing priority system may not have a very productive maintenance force. When a maintenance force begins weekly scheduling in earnest, many plants see their complaints shift to finding enough work to keep the maintenance force busy. The conundrum is that without a decent priority system, it is hard to begin the weekly scheduling effort. The lesson is to go ahead and create a simple workable priority system, and then start weekly scheduling as soon as possible.

A sophisticated priority system is not "the answer." The answer is to do the right maintenance at the right time. To make this work, we must identify enough of the right work and coordinate it with a productive maintenance group. Use a simple priority system to help coordinate and boost your maintenance effectiveness.

Credits

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Doc Palmer, PE, MBA, CMRP is the author of McGraw-Hill's Maintenance Planning and Scheduling Handbook and as managing partner of Richard Palmer and Associates, he helps companies worldwide with planning and scheduling success.

For more information visit www.palmerplanning.com or email Doc at docpalmer@palmerplanning.com

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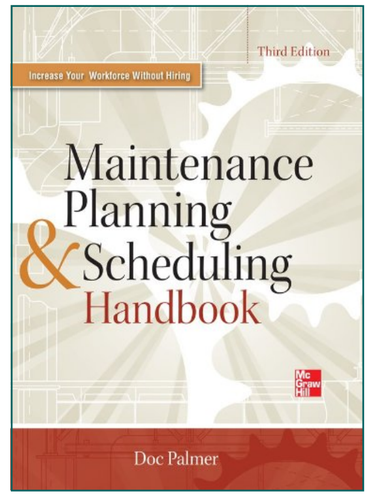

Authored by R.D. (Doc) Palmer

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The Workshops are presented by Richard (Doc) Palmer

Doc Palmer has over three decades of industrial experience as a practitioner within the maintenance department of the Jacksonville Electric Authority, a major United States electric utility. From 1990 through 1994, Palmer was responsible for overhauling the existing maintenance planning organization. The resulting success played a role in expanding planning to all crafts and stations owned and operated by the utility.
Publisher McGraw-Hill subsequently sought out Palmer to author the Maintenance Planning and Scheduling Handbook published in 1999 and now in its third edition (2013). Palmer also directed the purchase and implementation of a CMMS and administered the preventive maintenance program.

Currently Palmer provides guidance, mentoring, and training for companies internationally for maintenance planning success.

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Successfully Applying CM To An Autogenous Mill in the Mining Industry

Tim Sundström Research & Development, SPM Instrument AB Sweden

1 Introduction

An autogenous mill is a mission critical application found in the concentrator section of a mine. The mill's primary task is to grind ore into a suitable size for the next step in the concentration process.

There are many different types of mills; ball mills, rod mills, SAG (Semi-Autogenous Grinding) and autogenous mills. In a ball mill, steel or stone balls are mixed with the ore and during rotation of the drum the ore is ground, by friction and compression, into a suitable fineness for the next step in the process. A rod mill uses a similar principle, but the steel or stone balls are replaced by rods to create the grinding action.

In an autogenous mill, the ore itself is used in the grinding process and finally a SAG mill is a combination of a ball mill and an autogenous mill. In an autogenous mill, the presence of a sufficient amount of bigger parts of ore inside the drum is process-critical, or the grinding process will be ineffective.

The main component of all mills is a rotating drum turning with a suitable speed. The drum is normally coated on the inside by a rubber material. The ore is fed into the drum in one end and is crushed and transported out in the other.

As mentioned previously, the mill is a very important part of the concentration process in the mining industry. In many cases, the entire process can be severely limited or completely stopped if the mill ceases to operate and close observation of mill equipment condition is therefore essential. An unplanned stop must be avoided at almost any cost.

SPM Instrument was invited to a major Swedish mining company, Boliden AB, to apply our most advanced online condition monitoring equipment on an autogenous mill in its site in Garpenberg, Sweden.

The actual evaluation of our system took place between January, 2012 and September, 2012. At the time of writing, measurement still continues and deviations are recorded and reported.

The purpose of the measurement trials was

1) to evaluate the current condition of the mill,
2) to find suitableparameters to trend and follow over time, enabling an early warning system and
3) to examine the possibility to find a way to optimize the grinding process by using relevant vibration and/or shock pulse measurements.

The main products for the Garpenberg mine are zinc, lead, silver and gold.

Figure 1 A SAG (Semi-Autogenous Grinding) mill, normally short with a large diameter.

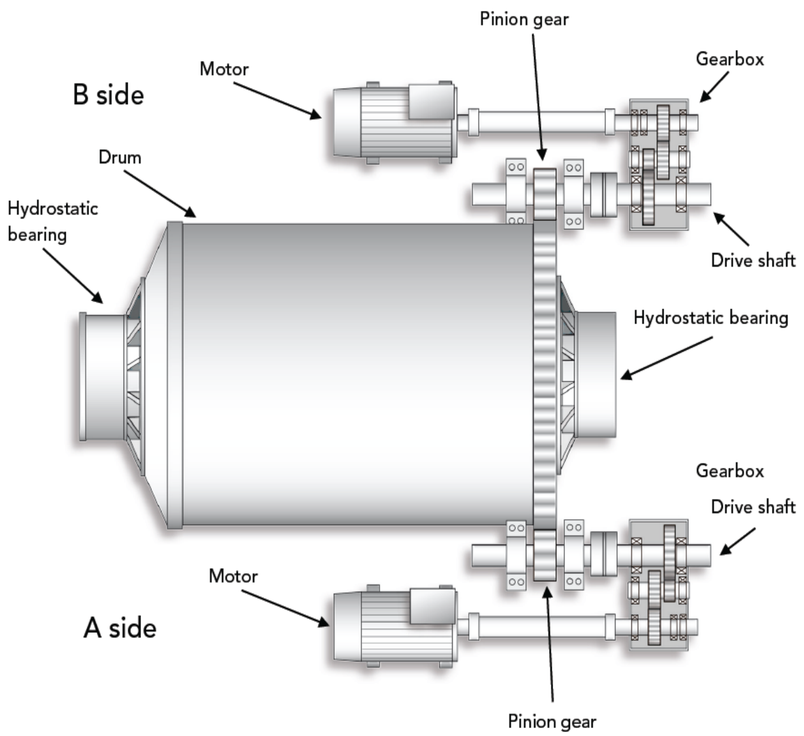
Figure2 An autogenous mill (primary mill 10, Boliden, Garpenberg).

2 Conclusion and summary

Condition of the mill

During the period from January, 2012 to October, 2013, two serious problems were detected well before any serious consequences. The first incident was a bearing damage found in one of the two gearboxes. The other was a loose gear (wobbling gear) in the same gearbox. Both of these problems could have caused serious malfunctions with severe economic consequences, had they not been detected.

Figure. 3 The autogenous mill seen from above



The combination of vibration and shock pulse measurement is ideal for this type of application. The shock pulse technology is very suitable for detection of bearing damages in “noisy” environments like the gearboxes in this case study. Vibration technology is optimal for low frequency-related fault conditions like unbalance, loose gears and misalignment.

After more than 21 months of measurements the system is performing very well. Thanks to the sensitivity of the system and the long forewarning times, maintenance actions can be planned well in advance, thus creating a sense of being in control of this mission critical application.

3 Application description

The main part of an autogenous mill is the drum. In this case, the drum inner diameter is 5.1 meters and the outer diameter 6 meters. The drum rotates at 15.7 RPM. The resulting peripheral speed is approximately 5 m/s. The drum is driven by two frequency-controlled motors on opposite sides of the drum. Via a two-stage gearbox, a pinion gear drives the drum itself.

In total, 28 transducers are used to cover the entire mill; twenty shock pulse and eight vibration transducers. Also, two RPM probes are mounted on the drive shafts.

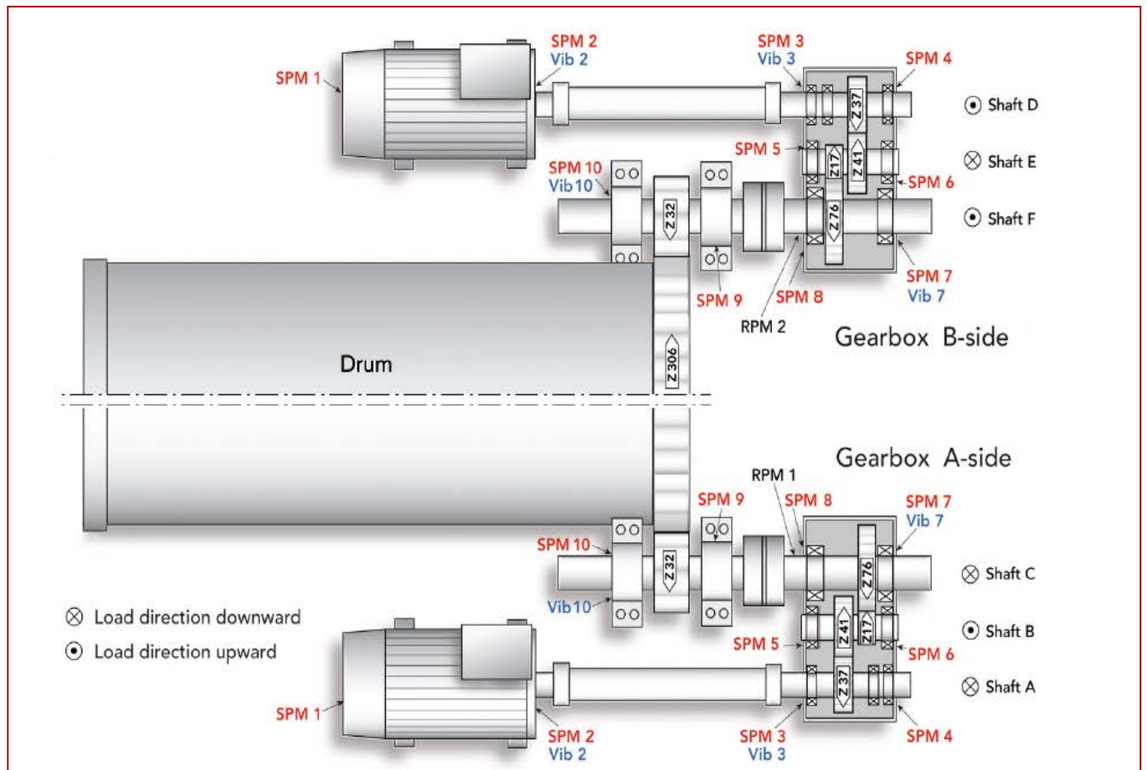
The motor (RPM=744.9) drives the gearbox via a cardan shaft. The gearbox reduces the speed (1:0.202). The gearbox output shaft drives the drum via a pinion gear. The whole drum is supported by two hydrostatic bearings, the condition of which is not measured.

Figure 4 The drum interior during a service stop. The rubber lifters are clearly visible.

Inside the drum, there are 28 rubber “lifters” used to lift bigger stones of ore in a cascading motion, causing impact breakage of ore. These “lifters” will eventually wear down. Half of the lifters are lower in height.

For this type of application the speed of the drum is very important. Too high RPM will make the ore just follow the drum around, while too low RPM will not create conditions for the grinding. The speed at which the ore is following the drum around is called the “critical speed”. When discussing drum RPM, it is often expressed in fractions of the “critical speed” (in percentage).

Figure. 5 Measuring points; shock pulse measuring points in red and vibration in blue.



4 System setup

4.1 Measuring equipment

The total number of transducers used for this application is 28, fourteen on either side; ten shock pulse transducers and four vibration transducers on each side covering the motor, the gearbox and the drive shaft. The shock pulse transducers are mounted as closely as possible to the load zone in order to cover bearing-related signals, while the vibration transducers are mounted to cover low frequency movement and not necessarily in the load zone.

We use two Intellinova Compact versions (INS18) because of their excellent measuring performance.

Utilizing ten shock pulse and four vibration channels per Intellinova Compact leaves two spare channels per measuring technique on each Intellinova Compact unit.

A 3G modem is connected to handle both Intellinova Compacts. The database and the Linx software are installed in the SPM network in Strängnäs. Thanks to the buffering capability in the Intellinova Compact units, even a temporary loss of communication will not cause any loss of data. With this system setup, we are able to fine tune alarm limits and the measurement setup directly from SPM.

We use two separate inductive probes for RPM measurement, one on each drive shaft. It is very important to have a good quality RPM signal to enable Order tracking to work optimally.

To enable mill operators to follow critical trends, the “Trends via Internet” function in Condmaster is used.

4.2 Measuring technique(s)

In order to cover the bearing condition of motors and gearboxes as well as drive shafts, we use shock pulse transducers (type 44 000). The shock pulse transducers combined with the SPM HD technology have superior bearing condition detection capability, making it an easy choice.

We decided to add four vibration sensors (SLD144B); one on the motor, two on the gearbox (horizontal and vertical) and one on the support bearing for the drive shaft (vertical). The shock pulse transducers do not detect low frequency signals from unbalance, misalignment, soft foot etc, so the purpose of the vibration transducers are to cover that type of low frequency movement.

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Using shock pulse transducers for bearing condition assessment in a gearbox is very efficient. The multiple gear-mesh frequencies in a gearbox significantly affect normal vibration transducers, making the spectrum and overall values very hard to interpret. The shock pulse transducer however is not affected by the gear-meshes (if there are no gear damages), so the readings are very clean and crisp, showing only bearing condition.

The reason for this is that normal mesh frequencies are too low to be detected by the shock pulse transducer. If a crack or surface imperfection were to occur in one or several gear teeth, the shock pulse transducer would react due to the shocks.

4.3 Condmaster setup

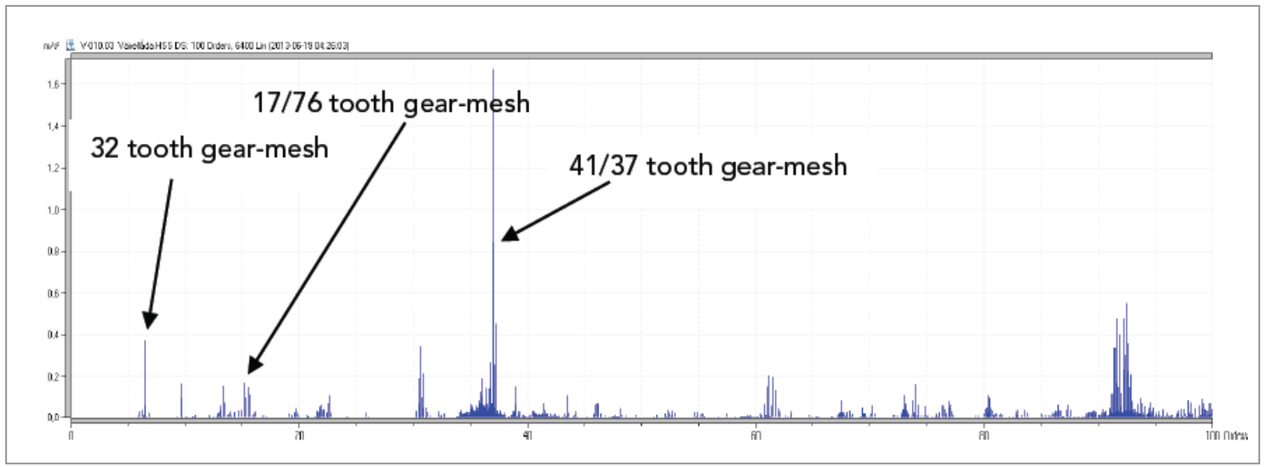
Because the mill is running continuously, no triggers or measuring conditions are applied. The parameters followed and trended are HDm for all shock pulse measurements (a moving average filter with ten readings turned out to be useful to avoid false alarms caused by single impacts) and vibration velocity RMS (here too a moving average of ten values is used).

For gear-mesh trending, band values from acceleration spectrums are useful, again with a moving average filter of ten readings.

The measurement interval is set to one reading every hour, but due to the amount of channels the practical measurement interval lands at one reading every 1.5 to two hours. This could be changed to two readings per channel per day; since the damage development process is relatively slow, two readings per day is more than enough.

The standard spectrum setup for the shock pulse readings is 1600 lines, symptom enhancement factor = 10 and an upper frequency of 100 orders.

Figure. 6 A 6400 line acceleration spectrum from “Vib3”. Three distinct gear-mesh peaks with harmonics can be observed. Only the main frequencies are pointed out.



The “Vib 3” vibration transducer mounted on the input shaft of the gearbox is used to detect all gear-mesh frequencies in the gearbox. We use a 6400 line spectrum, order tracked with an upper frequency of 100 orders. Because this shaft is turning with the highest speed (744.9 RPM), the 100 order upper frequency setting enables all gear-mesh frequencies to be detected in the vibration spectrum. A high resolution of 6400 lines reveals all details at lower frequencies.

By applying bands around the gear-mesh frequencies in the spectrum above, the gear-mesh amplitude can be trended, revealing gear problems in the gearbox.

5 - Case descriptions

5.1 Case #1
The loose gear in the B side gearbox

On November 5, 2012 it was decided to replace the B side gearbox with a spare one. The reason for the gearbox replacement was the decision to replace the bearing described in Case #2. When the gearbox replacement was started, the acceleration spectrum from measuring point “Vib 7” displayed elevated acceleration values.

Figure 7 The acceleration trend with clear elevated values in November 2012. The gearbox was replaced again with the original gearbox, resulting in lower values.

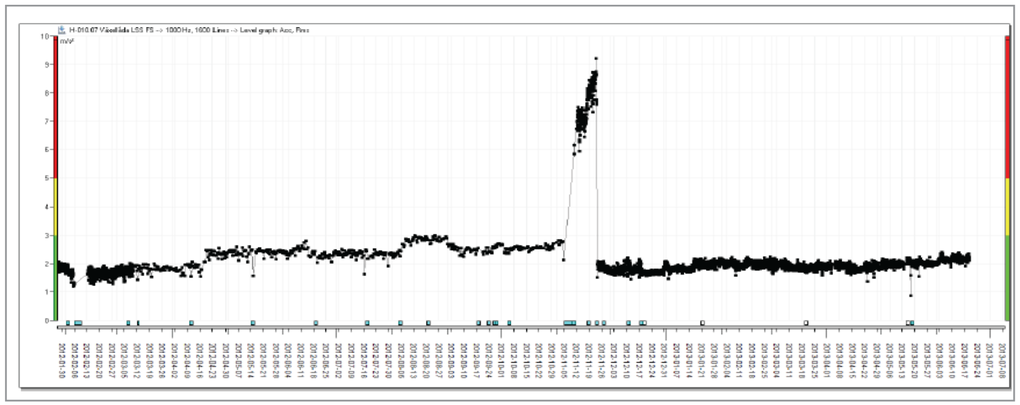


Figure 8 An acceleration spectrum showing strong gear-mesh frequencies with sidebands corresponding to the 41/37 gear mesh.

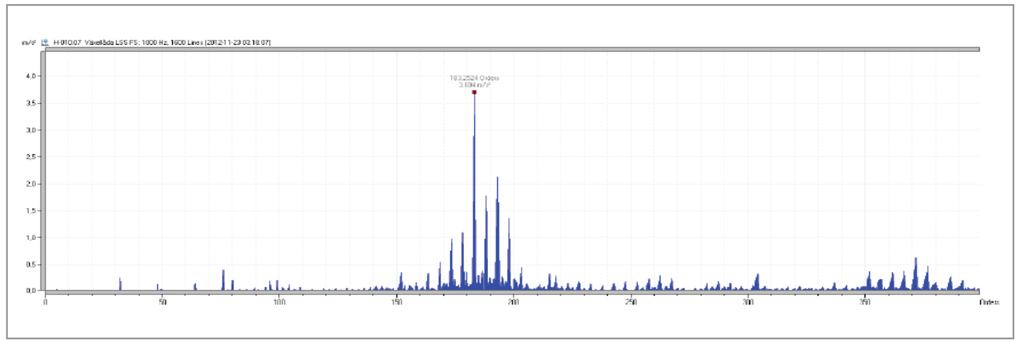
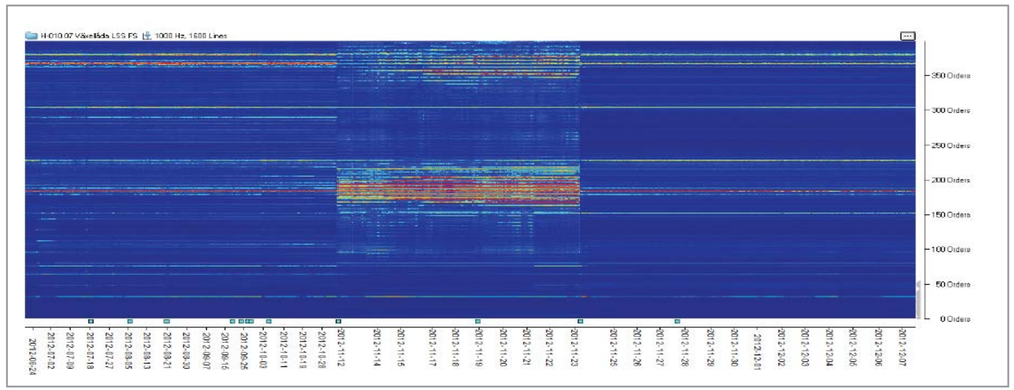


Figure 9 A Colored Spectrum Overview screen shot. Note the very clear change of the patern.



It was discovered that the 37-tooth gear was wobbling when turning, causing the clear acceleration trend. This fault could have caused severe damages if undetected. There could also have been risk for personal injuries due to the high forces involved. The personnel at the mill decided to continue to run the gearbox until the other one was repaired. During twelve days of running the wobbling gear, the operators closely watched the Internet trends looking for any dangerous developments. It was also decided not to allow people to come close to the gearbox due to the risk of injuries. Finally, the gearbox was replaced with the repaired gearbox and the trends went back to normal levels.

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Reliability Centred Maintenance & PM Optimisation Team Member	2 Day	Perth - 18 - 19 March 2014, 8 - 9 July 2014, 18 - 19 November 2014 Brisbane - 25 - 26 February 2014, 26 - 27 August 2014, 14 - 15 October 2014 Sydney - 3-4 April 2014 Melbourne - 11-12 September 2014
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5.2 Case #2;
Inner and outer race bearing damage

The drive side of middle shaft of the B side gearbox (SPM 5 B side) showed, from the very first reading in January, 2012, a very unstable trend. The readings sometimes showed a clear outer race signal pattern and sometimes a clear inner race pattern.

On bearing replacement, clear inner and outer race spalls were found in the bearing (see figure 10).

Figure 10
The inner race of the LSL192326 bearing.

Interestingly enough, only three months after the replacement with a new bearing, it showed an increasing trend; this time with a very clear outer race spall. The bearing has not yet been replaced (October 2013).

Figure 11 The HDm trend from February 13, 2012 to November 5, 2012.
Highly fluctuating readings throughout the measuring period.

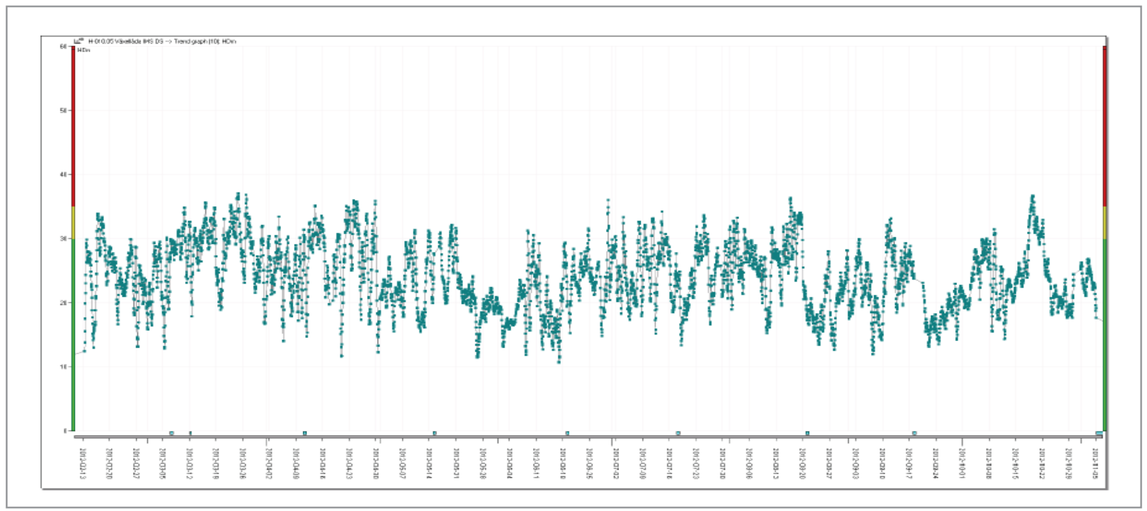
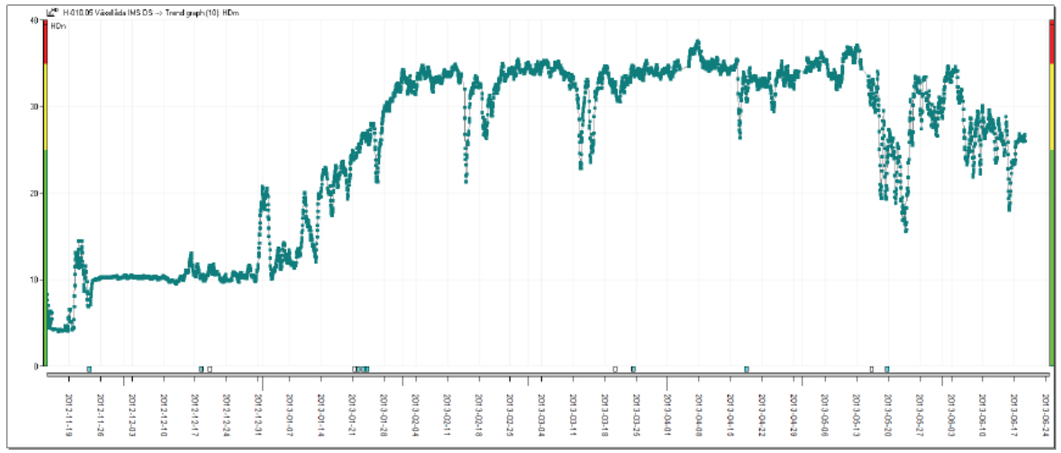


Figure 12 The HDm trend of the new bearing, a clear increase.
Timespan: November, 2012 to June, 2013.



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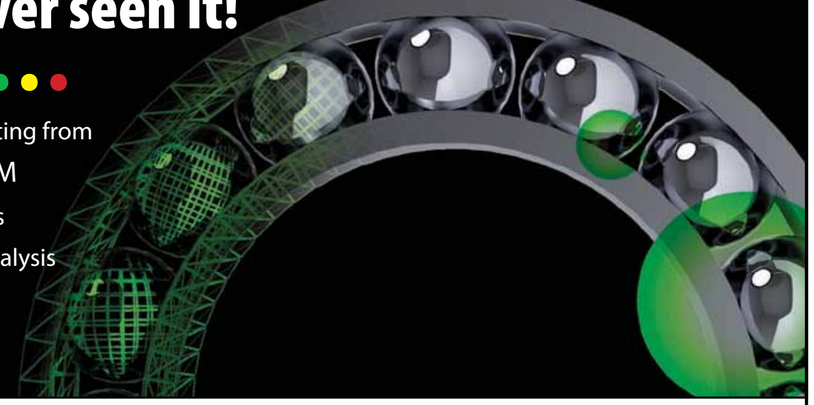

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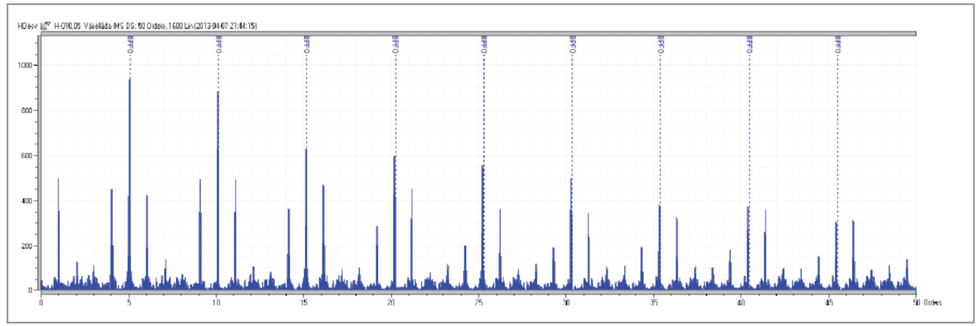

Fig. 13 Spectrum from April 7, 2013; a very clear outer race signal with 1 X sideband Note the very crisp and clear outer race signal, not affected at all by the gear-mesh frequencies in the gearbox.

The fact that even the replaced bearing shows clear outer race signals after only a couple of months in operation leads to the conclusion that this is a weak point in the gearbox design.

6 Appendix

Two low frequency Wilcoxon transducers were mounted on the hydrostatic bearings. Even if the signal is of low amplitude, a pattern with fourteen stronger and fourteen weaker signals can be seen. They correspond to the all in all 28 rubber "lifters" inside the drum.

Time synchronous averaging with 50 readings was used in order to average away the nonsynchronous signals. We are investigating if the "lifter" signal can be used for lifter wear trending. This test is still continuing.

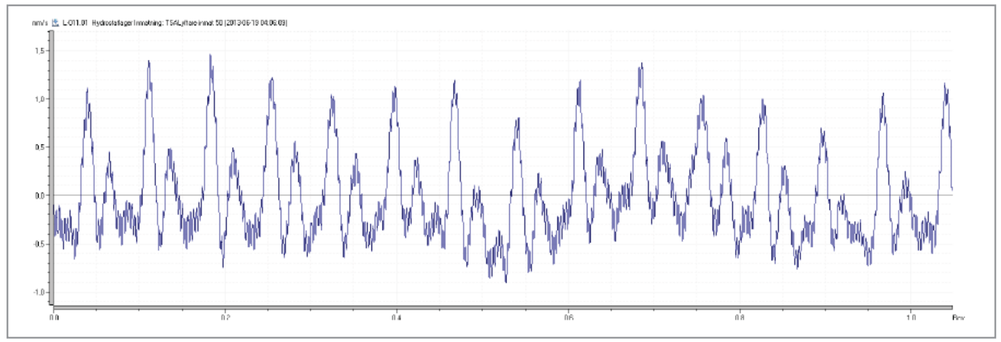

Figure 14 A time synchronous vibration reading showing the high and low lifters.

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http://www.metallerochgruvor.se/2012/10/spm-instrument-levererar-system-till-boliden (Swedish)

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How vulnerable are your production processes?

Philip Sage
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If your production processes aren't firing on all cylinders – and costing your business much more than they should – here is a very fast, very focused solution: the Vulnerability Assessment and Analysis (VAA).

Let's look at a hypothetical situation:

You are the new Director of Reliability for a global company, and you've inherited a floating oil production rig in the North Sea. When you start working with the platform team, it quickly becomes obvious that a number of issues are hampering the rig's performance. Some of these issues are known to the team, others aren't.

There are lots of little things that aren't perfect. One bigger issue is pretty clear and takes more of the blame for poor performance than it should. The machinery on the rig isn't geared for the specific gas-to-oil ratio coming on board to be processed – it isn't engineered to perform at its 'sweet spot' for this oil.

Other problems are less clear, although you know they are there. For example, you suspect critical spares and maintenance strategies need work.

You can see that the rig team has been persevering because they are more focused on getting today's job done, rather than on improving the assets' performance. For them, the work on continuous improvement has been replaced by the reactive task of fixing problems, and the culture of excellence has faded and been lost amidst day-to-day operations.

This is despite the fact that the under-performing production processes are costing the rig hundreds of millions of dollars a year in revenue.

As the newly appointed Reliability Director, you want to produce a shortlist of action items that will reduce the excessive maintenance costs and boost the rig's performance. You want a process that will lay all the cards on the table, so all members of the rig's team can refocus on what needs to get fixed first.

Enter VAA, a very fast and focused methodology that can be used in any production industry by any company that suspects its production processes aren't up to speed.

Quartile performance

VAA is an effective way to plot a path to best in class performance. In the case cited above, a VAA will reveal to the Reliability Director and his wider team that almost 500 vulnerabilities exist on the rig, which have caused them to slip from the first quartile to the third quartile.

The quartile ranking is a way of grouping assets depending on their performance, and is a means for identifying how you can become best in class. Those in the first quartile are the star performers. Their assets are efficient and cost-effective, and enjoy a 10-15 per cent lower maintenance cost as a percentage of sales than a similar asset that wallows in the fourth quartile.

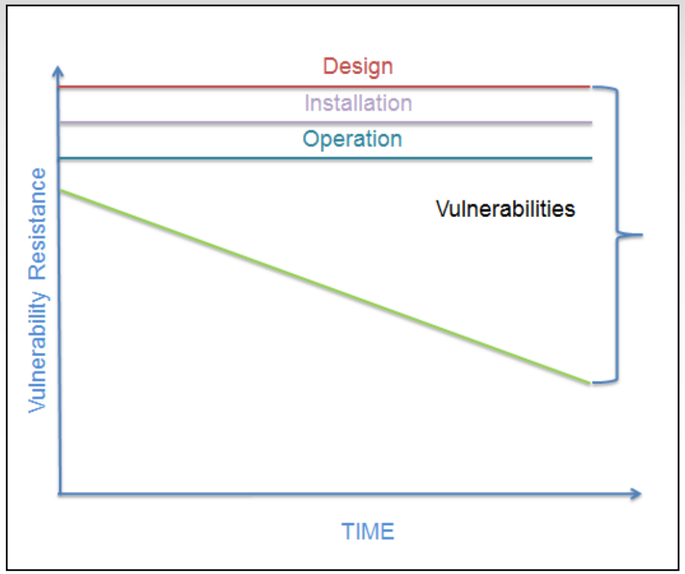
	Quartiles		
Category	**1st**	**Middle**	**4th**
Asset up time & availability	**92%**	**88%**	**79%**
Asset productivity as % of capacity	**90%**	**82%**	**69%**
Return on invested capex	**97%**	**77%**	**59%**

A series of indicators are used to identify which quartile an asset resides in; and organisations often find their assets are spread across all four quartiles depending on their age, management and maintenance philosophies, and so on.

Here are some classic examples of indicators that reliability engineers use:

In most cases, when an asset is first installed, its investors think it should sit in the first quartile. It is expected to perform well, be carefully managed and produce the desired results without surprises or disasters.

Figure 1



Over time, however, asset performance inevitably slides. This may happen for many, many reasons, such as: the operational or maintenance teams didn't follow processes as well as they should have; there was a change in personnel without the requisite handover of knowledge; or a tightening of budgets impacted on maintenance procedures. Slowly, the asset decays and slips into the lower third or fourth quartile of performance.

If your asset is not living up to its full potential, you should consider investigating performance with a VAA to quickly and efficiently identify priorities for fixing production processes and procedures, and deliver huge cost savings to the organisation.

Teamwork is key

There is a reason VAAs work. The secret behind the success of VAA is the fact that it relies on input from all areas of the company. VAA brings together a cross-functional team – ideally facilitated by an outside expert – to sit down and identify all the issues, and then map a pathway that prioritises how to get the assets and production processes back into the first quartile.

By taking a team-oriented approach, VAA identifies all of the issues that are affecting the production process or a broader scope boundary – and not just the ones that a single person knows about. Often, through this process, issues are brought to the table that some team members never knew existed. As a side benefit, VAA is a perfect training program for new staff. In one week you review every part of the entire process, and they participate with their new team and learn.

As the VAA progresses, all the varied issues are listed, and it becomes easier to prioritise those problems that are affecting the organisation the most. Having a qualified list of prioritised actions allows you to confidently start remediation of issues on the largest

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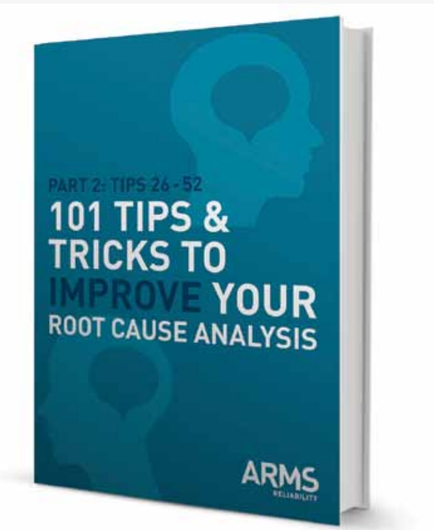

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impact area(s) first. Communication is key with any process, and communication of the remediation roadmap is critical. Armed with a professionally prepared executive report from the VAA the sponsor is kept abreast of high level and immediate severe impacts if they surface.

The core team can finalise the processing of the data, which includes an intense validation effort by the ownership team and delivers the prioritised action items with recommended action plans and remediation steps.

How long does this VAA process take? To give an example, let's look at a typical oil platform. A VAA of an entire oil platform could be conducted in one week – as long as the platform was well managed. If the majority of assets on the platform were sitting in the fourth quartile, then it could take up to two weeks to fully document all of the issues and produce a list of corrective actions. In other words, the timeframe is kind of dependant on how problematic things were to start with.

Getting outside help

VAA works best when an outside facilitator is brought in to mediate and provide objective analysis. This helps to establish an environment of trust and sharing that is often not possible with internally-led processes. In addition, a lot of work goes on behind the scenes by the facilitator, including pre-VAA investigations to identify the right questions to ask during the session; to identify the right people to bring to the session; and to educate these people about what the session will involve.

This facilitator plays a fundamental role in bringing the team together. Often, the cross-functional team involved in the VAA haven't met each other before – even though they work for the same company. In some cases, two people who are responsible for the same asset will meet for the first time in a VAA session.

The facilitator typically asks about 10 fundamental questions, which are designed to probe into the corners of the asset or production process to search out the vulnerabilities. These questions vary, and are tailored to the asset and the industry vertical the company operates in.

The analysis can be likened to a Hazop for Reliability except that it is not performed at the microscopic level. Much like Hazop, VAA relies on keywords and probing questions to get the team's collective brain wrapped around the problem. Yet VAA is done at a high enough level to unlock the team's knowledge about the asset or production process quickly, and to discover what vulnerabilities exist.

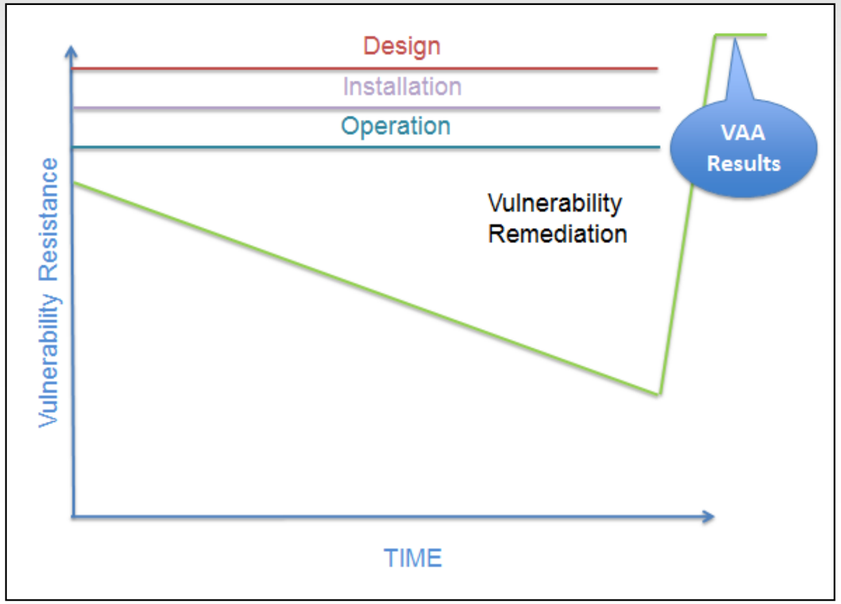
Software tools are used during VAA make the process more efficient and easy to validate. A multiuser database enables team members from all over the world to simultaneously provide their input into the process. When you're looking at, for example, 400 vulnerabilities at one time, you can't do it in Excel.

Delivering strong results

The goal of VAA is to produce a prioritised list of corrective actions – things that will get the assets performing better than ever before. Figure 2 is what that looks like.

Armed with this list, the team can then agree on the best way to achieve the corrective actions. For example, Root Cause Analysis (RCA) and Reliability Centred Maintenance (RCM) can be used to uncover why a vulnerability exists, as well as design reviews, and other mini projects.

Figure 2



These remediations can take weeks or even months, but it's worth persevering. With the VAA process you will be certain that you're addressing the right issues and targeting the largest impact first, and that the remediations will deliver strong results and significant savings in the long term.

ARMS Reliability is a global team of consultants specialising in reliability methods. Vulnerability Assessment and Analysis is one of the tools they deploy to assist companies to focus their improvement efforts and minimise loss. It is an overarching methodology that is performed at the top level, and often precedes more detailed analysis methods such as Root Cause Analysis and reliability studies. www.armsreliability.com

Change Management in Reliability

Paul Casto Meridium USA

There are numerous books and articles written about change management and it has the attention of many managers. Yet projects involving significant levels of change continue to fail at an alarming rate. How bad is it?

According to Arthur D. Little and McKinsey and Co., about two-thirds of TQM programs and 70% of re-engineering efforts fail.

In Dance of Change, Peter Senge says, “This failure to sustain significant change recurs again and again despite substantial resources committed to the change effort, talented and committed people driving the change and high stakes.” He goes on to say, “Companies that fail to sustain significant change end up facing a crisis. By then, their options are greatly reduced and, even after heroic efforts, they often decline.”

Many of us have felt the sting of projects that didn’t achieve the expected level of success, even though the technical solution was sound, perhaps even elegant. On the other hand, some of us have experienced projects that have achieved two to three times the expected results.

The common denominator between these successes and failures is likely ‘soft’ issues, i.e, those associated with people, change and sustainability.

Why, if most managers realize the importance of change management, does managing change continue to be such a huge problem for organizations? One reason is that these soft issues are often outside of our comfort zones. While engineers are good with technical problems, leading change and dealing with people can be a foreign concept.

So what should we do? While developing detailed expertise in this area requires a broad range of experience, there are some proven, common sense steps that can enhance the probability of maintenance and reliability (M&R) project success.

Projects that are focused on improving M&R are often focused on reducing the amount of reactive maintenance work and transitioning to a more proactive maintenance approach.

There are three parts of M&R projects that must be addressed to improve the odds of success. These are:

1. The technical solution
2. Work processes and culture change
3. Leadership

These elements are interrelated as shown in Fig 1.

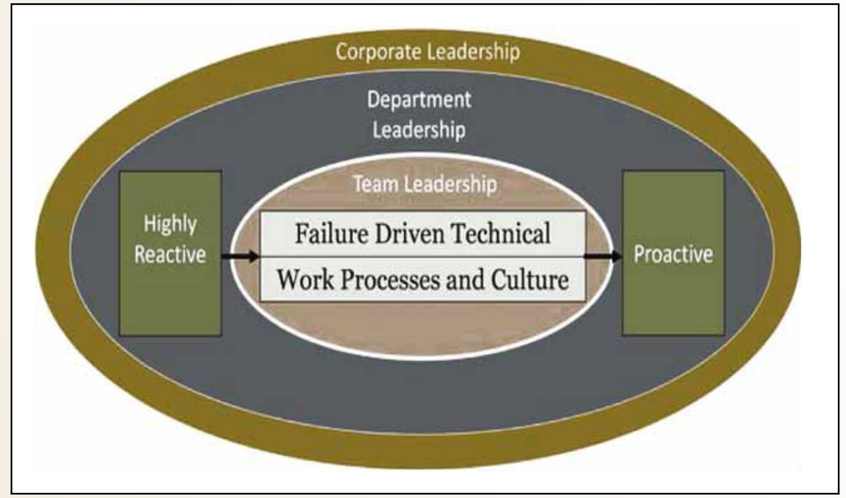


Figure 1: Key Elements of Success

I have seen this model executed numerous times and I have learned that while all three elements are required to achieve maximum results, work processes and culture change are at the heart of a successful outcome.

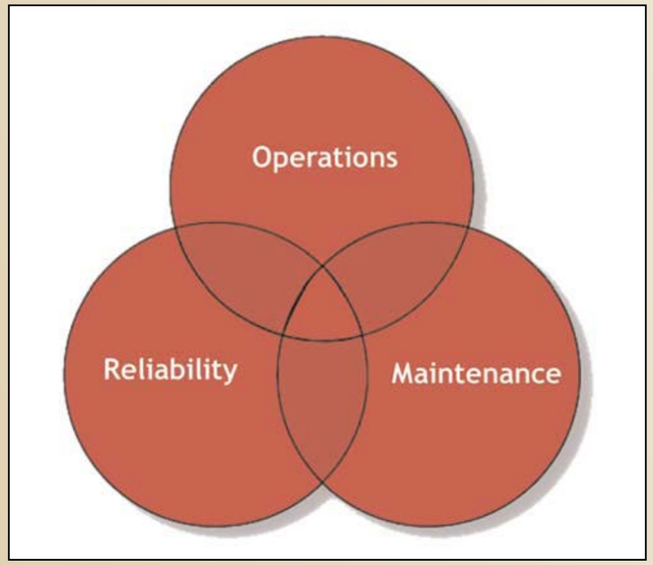
Successful execution of this model is hard work and requires focus, commitment and strong leadership at all levels of the organization. It also requires that project execution be shifted away from simply a cost, schedule and budget focus to an equal focus on work processes and people. This is no trivial commitment; in some cases members of the execution team may need to spend up to 50% of their time on these soft issues.

While this may seem like a large commitment, I believe it will dramatically improve the chances of achieving success. After all, we have too often witnessed the failure of the typical cost, schedule and technical execution model.

Successful implementation of this model to M& R projects can be accomplished through the application of these practical steps:

1. Fixing broken work processes
2. Mending broken relationships
3. Building sustainability into the process
4. A structure for change management

Figure 2: Work Process Interfaces



Fixing broken work processes

Work processes are central to almost everything we do in maintenance. We have a work process for everything from planning and work order management to work scheduling and spares management. Often these work processes are not functioning efficiently enough to provide consistency of data flow and in some cases they are just flat out broken. Without the structure that an efficient work process provides, everyone will have their own version of how to do things.

It is imperative that key work processes, especially those that occur at the interface points between maintenance, reliability and operations (figure 2) function effectively. In order to fix these work processes, it is often necessary to map the current work process and then develop the desired future state work process. The implementation of the newly developed, more effective work process will enable efficient information transfer and provide the foundation for long term sustainability.

Mending broken relationships

This is an interesting and often ignored step in the implementation process. Because people in different organizations have conflicting demands, high levels of frustration can result when they are forced to work with inefficient work processes. Working with these processes can cause frustration that is often manifested in a passive/aggressive manner. That is, people may not be outwardly hostile to their peers, but just under the surface there may be significant frustration in their working relationships. First, we must fix the broken work processes and then, we must work to mend team relationships. People want to do a good job; our job as leaders is to put processes in place to enable them to do their jobs and to also take the time to mentor and coach them so they are adequately equipped to be successful.

Building sustainability into the process

Another important aspect in successful M&R projects is sustainability. Sustainability is defined as the capacity to endure. What sometimes occurs is that projects are implemented with only a cost, schedule and technical focus. If the project yields positive results, celebrations are held, back slapping ensues and soon the project team moves on to other things. However, unless the changes have become ingrained into the daily work life of the plant, often within the next 12 to 18 months performance regresses and much of the gain is lost. This is often because the necessary work processes, role definition and training are not put in place to sustain the workflow.

It is critically important that the necessary systems and processes be defined and put into place which will create an environment for sustainability. Central to achievement of this objective are the work processes which promote the new workflows required to support the technical solution. Once again, work processes are critical to project success and the acceptance of change.

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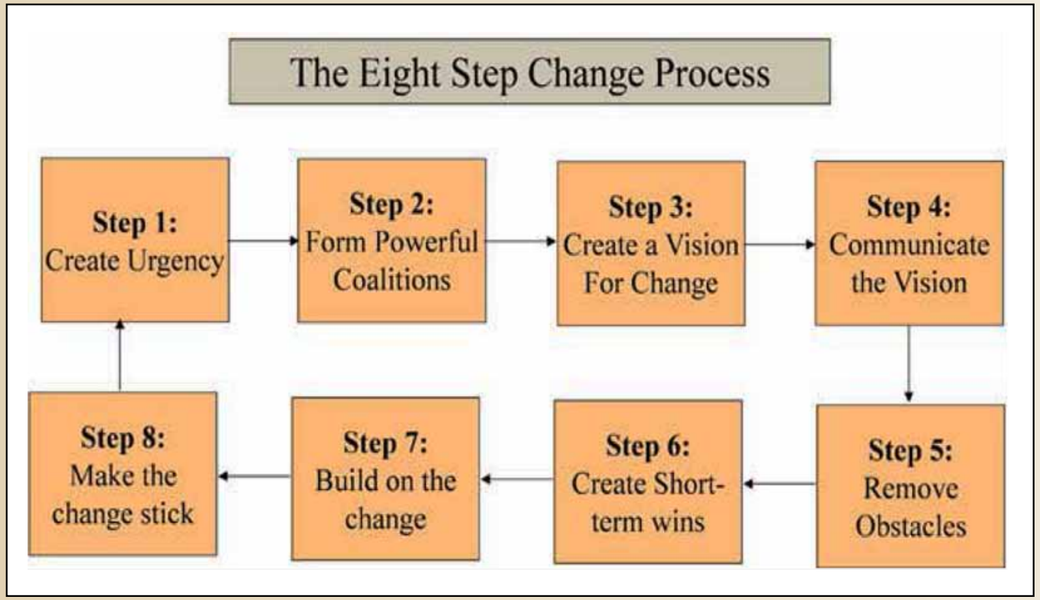
Figure 3: Kotter Eight Step Change Process


The Eight Step Change Process
Step 1: Create Urgency
Step 2: Form Powerful Coalitions
Step 3: Create a Vision For Change
Step 4: Communicate the Vision
Step 5: Remove Obstacles
Step 6: Create Short-term wins
Step 7: Build on the change
Step 8: Make the change stick

Structure for change management

It is important to have a structure in place to support change management. There are many models for this, but one of the most successful has been developed by Dr. John Kotter, who has written several books on change. His model for change is discussed in detail in Leading Change.

Kotter's model incorporates eight steps in the change process (figure 3) and can be summarized as follows:

Step 1:
Establish a sense of urgency

A Sense of Urgency: Creating and Keeping It, the lack of a true sense of urgency is a critical problem in many of our organizations. For change to be successful a high level of urgency must be created in managers and employees. Urgency occurs when people in the organization realize that there are dangers and threats to their business. These dangers spark people into action and they then communicate this sense of urgency to those around them.

It is easy to underestimate how hard it is to drive people out of their comfort zones, so the establishment of a high level of urgency is important.

Kotter notes that over half of the companies that he has observed fail to create enough urgency to prompt action. We have all seen M&R projects implemented with little communication or involvement of the people who will ultimately be tasked with using the new solution. Everyone in the organization needs to feel the urgency to change how business is done and be willing to move out of their comfort zones. The importance of creating a sense of urgency to drive successful M&R outcomes cannot be over communicated.

Step 2:
Form a power guiding coalition

Successful transformations require a large coalition of supporters to drive the change. Individuals alone, no matter how competent or charismatic, have the assets to overcome the inertia of 'the present.' Therefore, a coalition must be built. Depending on the size of the organization this should include several people of the leadership team who are committed to success. The power of the coalition is important to beginning the change process, communicating urgency and bringing others on board.

This guiding coalition is critical to overcoming any passive resistance from managers and employees unwilling to leave their comfort zones. It is the guiding coalition that over time will help overcome inertia.

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Step 3:
Create a vision for change

While urgency and a guiding coalition are necessary, there must be a vision in place to guide action. Forming a picture of the future that is "easy" to communicate and "appeals" to customers, stockholders and employees is vital to success. The vision provides motivation, keeps the coalition aligned, provides a target to measure how the organization is doing and serves as a constant reminder of the reasons for striving to overcome the present inertia. Kotter shares, "If you can't communicate the vision to someone in five minutes or less and get a reaction that signifies both understanding and interest, you are not done with this phase of the process." The vision needs to be clear, concise and understandable.

Step 4:
Communicate the vision

Simply put, when you feel you've communicated the vision adequately, keep communicating. Kotter says most transformations are under communicated by a factor of 10 (or 100 or 1000). Communication comes in both words and deeds. People appreciate leaders who are involved and "walk the talk." Nothing undermines change more than behaviors exhibited by leaders that are inconsistent with their verbal communication. Remember, people are watching our actions.

Step 5:
Remove obstacles that block the new vision

Successful implementation of major change requires a large number of people to chase the vision. Sometimes employees face obstacles to achieving the vision and feel disempowered. Obstacles come in many forms: organizational, job restrictions, compensation issues, regulations, etc. It is also common to find supervisors who don't want to adapt to the change and make demands that are inconsistent with the needed change.

It only takes one well-placed obstructionist to impact the change effort. Leaders must confront all obstacles in order to ensure that the movement for change is not undermined.

Step 6:
Create short term wins

Since real transformation takes time, the loss of momentum and the onset of disappointment can be real factors. Most people won't have the energy and commitment to stick with the change effort unless they see evidence that their efforts are bearing fruit.

This evidence comes in the creation of short term wins. Without short term wins, too many employees will give up. It should be noted that creation is not the same as hope, the latter is passive and the former is active. As leaders we must look for ways to obtain performance improvements quickly, clearly identify these successes and reward the people involved.

Neve underestimate the power of short term wins; they can be the difference between success and failure.

Step 7:
Build on the change

Kotter warns, "Do not declare victory too soon." It takes time for change to occur and the new approaches are fragile and subject to regression. Declaring victory too soon kills momentum and will allow the powerful forces of tradition to gain ground. The inertia of "the way we've always done it" is always lurking just below the surface of the change effort. Major change can take years to institutionalize so create short term wins and stick with the program.

Step 8:
Make the change stick

You know the change will stick with it becomes "the way we do business." Change has to become part of the fabric of the daily work life of the organization and it needs to be institutionalized by the supporting work processes. Until the new behaviors become the social norms and shared values, they are subject to the pressure to revert back to the status quo. A conscious effort must be made to show people how the new behaviors have improved the life of the organization.

People generally want a better work life and if the change leads to that, people will accept it. In addition, time must be invested in the next generation of leaders to ensure that the new approach is how they continue to do business.

Summary

Change management is a key part of successful M&R projects and offers the opportunity to leverage technical solutions for additional value. Central to change management are work processes.

These work processes provide the structure to consistently do work the right way, facilitate information flow and support the effectiveness of work teams.

There are four practical steps that can be taken to increase the probability of success when implementing change including: fixing broken work processes, mending broken relationships, building sustainability into the process and adhering to a change management process.

Remember, a leader is a dealer of hope. As leaders, it is our responsibility to provide the supporting structure necessary to enable our team, provide inspiration to fuel their progress and create a vision that gives them hope.

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A Decade Of Fruitful Network Asset Management in CLP Power

Chris Cheung & Chi-Pui Ng, CLP Power Hong Kong

The Power Systems Business Group (PSBG) of CLP Power has developed and implemented a structured asset management framework that has proved invaluable to the company's business performance.

Over a decade, PSBG has achieved more than 90% reduction in Customer Minutes Lost (CMLs) while simultaneously responding to a 20% load growth, expanding our assets, and maintaining our tariff competitive. PSBG has achieved such high supply reliability and cost effectiveness by continuously improving its asset management capability.

In 2007, PSBG was first accredited with a PAS 55 certificate for the optimal management of its physical assets.

This paper describes the implementation experience and critical success factors of PSBG's asset management system.

Introduction of CLP Power

More than a century ago, CLP Power (formerly named China Light & Power Company) was established to supply electrical power and street lighting to some of the residents in Hong Kong. Today, CLP Power operates a vertically integrated electricity generation, transmission and distribution business in Hong Kong and provides electricity to over 5.8 million people. Our network contains about 14,000 kilometres of overhead, underground and submarine cables that feed into more than 13,000 substations. Beginning in the 1990s, with a stronghold in Hong Kong, our parent company, CLP Holdings, has been expanding its energy business in China, and other Asia-Pacific countries such as Australia, India, Taiwan and Thailand.

A Decade of Asset Management Implementation

Before 1998, CLP Power's electricity supply business was served by three core Business Groups: the Transmission Group took care of the transmission network, the Distribution and Customer Services Group served the distribution network and retail business, and the Generation Business Group ran all the generating facilities. CLP Power restructured its organization in 1998 with the goal to enhance its marketing and customer services and achieve measurable improvements in the efficiency, reliability and quality of electricity supply. The Power Systems Business Group (PSBG) was established by merging the transmission and distribution functions, incorporating a central Asset Management Department (AMD) to better manage the combined T&D assets and capture the synergies of such integration. Network planners, asset planners and strategists were thus gathered together under the single AMD umbrella. This started our continuous performance improvement journey in asset management.

Since 1964, CLP Power has been operating under a Scheme of Control Agreement with the Hong Kong Government. The Agreement allows CLP Power a stable return for its investments as a vertically integrated electricity service provider. In 2002, in view of the electricity market reforms in North America and Europe which we envisaged would ultimately shape the electricity market in Hong Kong, PSBG reviewed its asset management processes so as to better prepare itself for a contestable operating regime. Based on the results of this assessment, a Strategic Asset Management (SAM) model was developed and adopted. In adopting SAM, several significant improvement actions were taken:

- Clearly defined roles of Asset Owner, Asset Manager and Service Managers. Partnership Agreements between Asset Manager & Service Managers were established to define the responsibilities and expectations of all parties involved.
- Consolidated the dispersed asset investment decision-making process. A centralized Investment Planning function was implemented. This avoided regional disparity of methods, priorities and duplication of efforts.
- Established a full life cycle asset planning process to create an integrated Asset Plan, thus avoiding the 'false economies' of chasing short-term cost savings that often result in higher O&M costs and performance problems subsequently.
- Established a risk management framework to standardize the PSBG risk management approach. This provided a consistent basis for investment and resource prioritization.

PSBG again reviewed its asset management model and practices in 2006, this time against the PAS 55 model. PAS 55 was, and still is, the only international standard for the optimized management of physical assets, first published in 2004 by British Standards Institution and subsequently adopted by, among others, the UK electric and gas utilities regulator.

PAS 55 provides a comprehensive scope and a recognised, transparent and measurable definition of good practices, including the need for continual improvement.

In 2007, CLP Power became the first Asian electric utility company to receive the PAS 55 compliance certificate. This involved an independent audit by The Woodhouse Partnership Ltd (TWPL), who also facilitated a subsequent roadmapping exercise to develop further improvement plans. Five strategic initiatives were identified to take the organization forward to higher levels of asset management excellence:

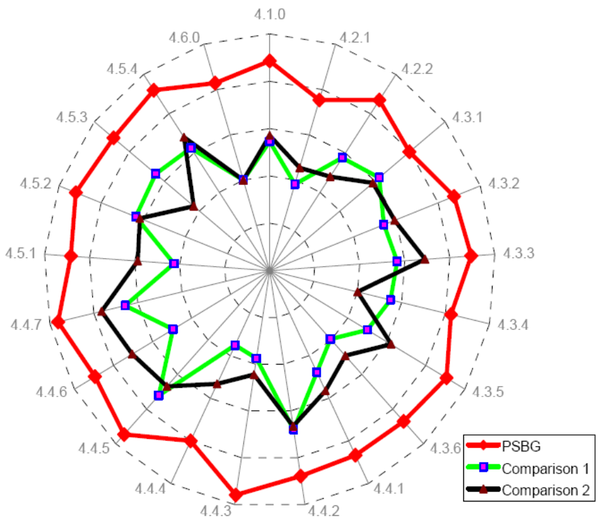
- Enhance Knowledge and Competency,
- Refine Capital Investment Process,
- Develop Innovative Supplier Relations,
- Optimise Maintenance Strategy,
- Achieve greater Engagement of Frontline.

These programmes were all implemented successfully and followed-up closely to improve PSBG's business. PSBG was again assessed and accredited by TWPL in 2010, under the revised and extended PAS 55:2008 standard.

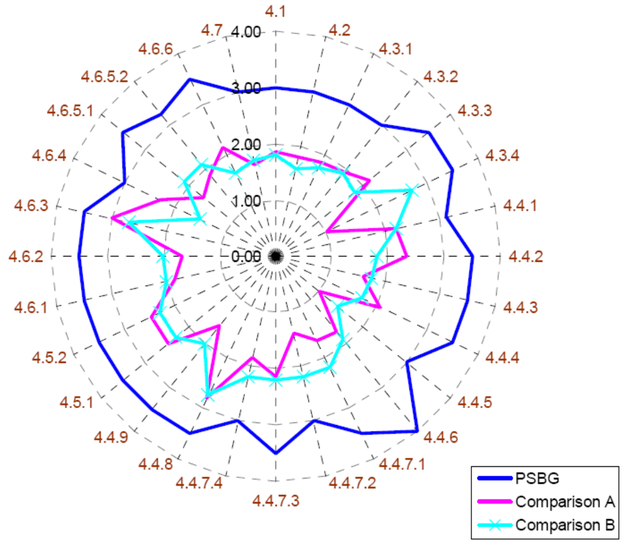
The results for PSBG's PAS 55 assessments in 2007 and 2010 are shown above, with benchmark comparisons against two similarly sized electrical utilities (the numbering relates to elements within PAS 55:2004 and PAS 55:2008 versions)

"The sustained accreditation demonstrates CLP Power's determination to pursue excellence in asset management. This will help us reach ever higher levels of asset optimization" said K.C. Wong, Deputy Director (Asset Management), PSBG.

2007 assessment results:



2010 assessment results:



Critical Success Factors in Asset Management

Given PSBG's vision to become a respected world class organization in the delivery of electrical energy, it continuously pursues the best industry practices and has spent over 10 years developing and refining its asset management approach. The experience tells us that good asset management results are built upon a foundation of critical success factors.

1 *Sustained Organization Commitment*

PSBG has adopted and retained asset management as a business approach for more than a decade. Both the management team and the organization are committed to the principles and methods of asset management. Throughout the years, PSBG strengthened its capabilities through continuous improvements, regular reviews, benchmarking and incorporating good practices.

2 *Organization Alignment*

The Asset Management Department (AMD) has served as a centre of excellence for asset planning within PSBG. The functions of network planning, asset strategy formulation, investment planning, performance management, procurement and information system support are brought under a single organization structure with asset management as its business focus.

AMD looks after the whole life cycle of all T&D assets in PSBG. Network development and asset plans are prepared and published annually to guide our actions in meeting future demands and challenges. Operation & maintenance strategies and standards are updated regularly to reflect the ever changing asset portfolio and operating conditions. Investment plans and procurement strategies are reviewed closely so that PSBG can better utilize its capital and benefit from quality suppliers. Performance data are monitored and analyzed to measure the effectiveness of different asset management strategies and to provide constructive feedback to strategists and planners. All these core asset management activities are centralised and efficiently designed, implemented, managed, and monitored by AMD.

3 *Change Management*

Asset management has been a major driver for continuous improvement within PSBG's operations. Many of the improvements bring along changes to our business practices, e.g. changes in standards, procedures, technical skills, business processes, IT systems and organization structures.

PSBG adopted a change management framework to better plan, execute, monitor, and adapt to the variety of changes. This provides a mechanism that effectively manages different types and sizes of changes, especially their impacts on safety, health, environment, security, regulatory compliance, plant integrity and reliability. It has strengthened our capability to ride through changes smoothly and efficiently. Undoubtedly, it also contributed towards the implementation of new asset management strategies.

The key steps of our change management are as follows:

- Changes are identified and risk assessment is performed;
- Control measures are devised to mitigate any risks identified and keep them at an acceptable level;
- Changes are documented, communicated to affected parties and training is provided as appropriate;
- The changes and their impacts are monitored during implementation.

4 *Collaboration Between Asset Managers And Service Managers*

Close collaboration and effective communication between Asset Managers and Service Managers are vital to align the direction and actions across the PSBG organization.

Communication mechanisms are established for all asset management activities. Building mutual understanding among stakeholders and gaining their support has been critical in joining up the jigsaw puzzle of different functional teams and their contributions. For example, when developing our asset management plans, the Asset Manager goes through 3 stages of communication as follows:

- Preliminary plan – used for consultation with Service Managers to collect their feedback;
- Draft plan – a refined plan for further discussion and consultation;
- Final plan – communicated with the frontline in road shows to solicit their support for implementation.

5 *Information System Support*

PSBG utilizes an integrated information system, the Enterprise Work Management System (EWMS) based on SAP, to support its construction, operation and maintenance activities. EWMS serves as our master asset register. It also captures and holds our cost and maintenance data, and provides various management reports for performance monitoring. EWMS has evolved to become a rich source of O&M cost and activity data. It was recognised in the PAS 55 assessments as having been particularly well implemented and exploited.

Utilizing its historical cost data, we have built a set of O&M unit cost reports, which allow the users to review cost information from various perspectives and at different granularities. For example, we can easily obtain the average annual labour cost incurred in routine maintenance of a specific make of 11kV switchgear during any specified period. Such unit cost information can also be used to support various management and planning activities, such as budgeting of annual O&M expenditures or contractor scope management.

Other vital support systems include Automated Mapping / Facilities Management (AM/FM) and Trouble Call and Outage Management System (TCOM). AM/FM is a Geographical Information System used to maintain the master records of power line assets. It also provides additional functions such as network analysis, trench work management and outage display. TCOM is used to track customers' trouble calls, dispatch emergency crews and record outage information. TCOM contains detailed information of all outages, such as outage classification, duration, and number of affected customers. The data facilitates accurate measurement and in-depth analyses on our reliability performance.

All these systems allow better understanding of asset costs and performance over any given periods. This knowledge enables our planners to make informed decisions and strengthens our asset management ability.

Our emphasis on having the fit-for-purpose information systems is reflected in our organization of IT services. In addition to central IT functions, there is a dedicated team within AMD whose responsibility is to identify and develop information system requirements and solutions. This ensures fit-for-purpose information systems and business processes to support effective asset management.

With excellence, we serve. CLP Power is committed to powering Hong Kong responsibly and providing the best services to our customers.

Our Challenges and Way Forward

In coming years, our business will see both new and on-going challenges in different areas:

- Excellent supply reliability and power quality must be maintained, if not improved. Supply reliability is ranked by our customers the most important element of our services. CLP Power's reliable services have very much become part of our citizens' everyday life and the slightest degradation will not be accepted.
- Following the world trend, Hong Kong Government is also taking a keen interest in the electricity industry. There is tightening regulatory oversight on CLP Power's investment & service performance.
- Customers expect a low tariff. Tariff increases are often perceived negatively and criticized by pressure groups.
- The aftermath of the financial tsunami is lingering. While the world economy is still on uncertain ground, the governments' monetary policies may lead to unexpected results. Commodity prices (for fuel and metal) and civil construction costs will be highly volatile.

• The expiry of the current Scheme of Control in 2018 or 2023 at the latest (if the Government elects an extension) may pose a new business framework for the power industry.

• To fulfil its social responsibility, CLP Holdings is answering the call for a cleaner environment and is striving to reduce its carbon footprint. To support the Group's low carbon position, various green technologies and initiatives, usually at higher initial costs, have been adopted in recent years in the Hong Kong business. CLP Power's plan for a much lower carbon intensity in its generation portfolio by 2020 will further increase our cost pressure.

• Smart Grid initiatives are picking up speed in many countries. A wide range of smart devices and technologies may bring significant changes to our industry and our mode of operation.

To meet these challenges, the latest (2010) asset management roadmapping review identified our priorities ahead:

• Further enhance customer satisfaction and loyalty by understanding customers' values and proactively anticipating and meeting their needs;

• Maintain our network and assets in their optimal conditions to ensure reliable and quality supply for our customers;

• Further improve our condition-based maintenance (CBM) and asset-based risk management (ABRM) systems to optimise asset performance and associated expenditures;

• Implement prudent cost management measures (e.g. investment prioritization, better cost transparency, partnership with contractors) to control our costs;

• Develop our staff's technical expertise and commercial mindedness to handle future uncertainties in our business;

• Continue to explore and implement green and smart grid technologies.

Asset management will continue to play a vital role in our pursuit of excellence. We have adopted the strategy of minimizing the total life cycle cost of electrical equipment. Some past examples were the adoptions of gas insulated switchgear, XLPE cable, pole-mounted gas switch, etc. These are more robust equipment having fewer maintenance requirements, resulting in lower life cycle costs.

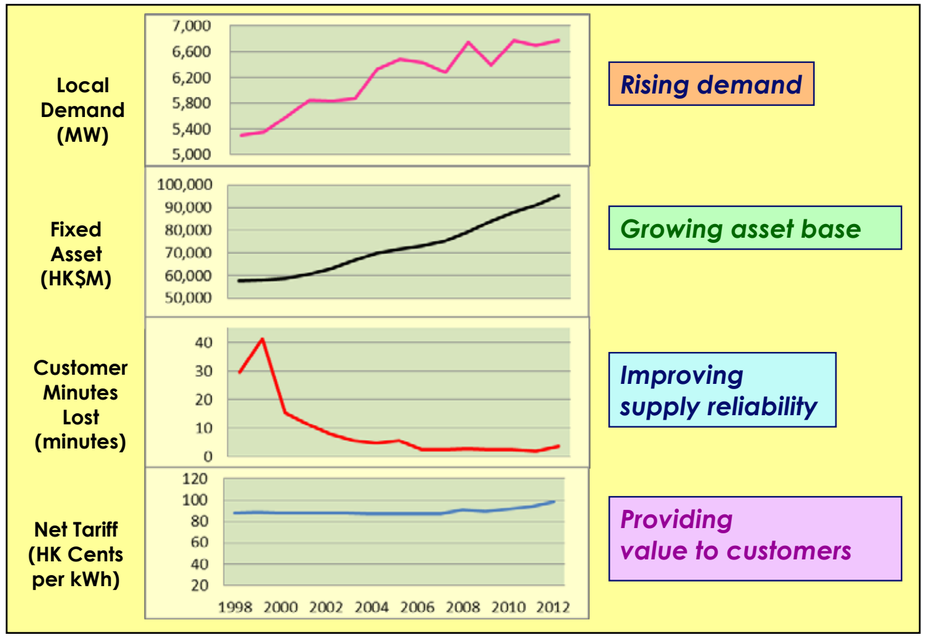
We have adopted an Asset Based Risk Management (ABRM) scheme in which we prioritise our investments by analyzing the current and future conditions, performance and risk for our network assets. By adopting innovative online condition monitoring technologies, we can also continuously assess the real-time condition of equipment so that the appropriate maintenance can be carried out at the right time – striking the best balance between using the equipment to its maximum capability and minimizing disruption from possible failures.

In 2014, PSBG will review its asset management system and practices against ISO 55001, the latest international standard, with the aim to further strengthen our asset management capability.

We are more than 100 years young. The next hundred years for CLP is a journey for us to shape.

CLP Power's Performance in a Decade

The structured asset management framework has contributed much to CLP Power's success in the last decade. Today, Hong Kong is an energetic and prosperous city: our business and the electric power network have grown rapidly in response. Yet we also achieve very high supply reliability at an affordable tariff. The following charts summarise our key accomplishments.



Asset management experts from TWPL observed; "PSBG is a shining example of outstandingly good asset management practices and processes - we are always impressed with the way they set themselves tough challenges and consistently achieve their goals."

Acknowledgement

We wish to thank the Management of CLP Power for their support in the preparation of this paper.

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Julie Fowler (julie.fowler@twpl.com)

Contamination and Bearing Life

A good tip for bearings is:

Don't wash new bearings.

Bearing manufacturers take great care to package and ship bearings that are dirt-free and ready for lubrication. There's usually no need to wash them or remove the protective slushing compound.

Dirt is one of the worst culprits to achieving superior bearing life. Small, hard particles (rust, grinding wheel dust, blasting particles) or large soft particles (hair, threads, paper dust) can both cause denting inside bearings in operation.

The bearing oil film is less than a micron thick(about 40 millionths of an inch), so the bearing simply crushes dirt right into the raceways, causing denting.

Laboratory studies reveal that just 10% denting of bearing raceways reduces the service life by 90%!

Not washing new bearings is a basic first step in contamination control.

A few other recommended best practices for your shop:

1. Arrange your shop to physically separate clean and dirty areas by at least 10m (~30 ft.) Solid walls are best, but even moveable barriers like welding screens around the assembly area help.
2. Frequent wet mopping (or wet mechanical scrubbing) will remove dirt. Sweeping or using an air hose simply stirs up dirt or just moves it around.
3. Check frequently to make sure new sources of contamination haven't appeared. A good example is a "flapper wheel": your mechanics say they have to remove surface corrosion from parts. Ensure the tool is used only in the "dirty zone" instead of the clean assembly area of the shop.

Article courtesy of SKF @ptitude Exchange www.skf.com

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Jeff Poloni - Planning Manager and Overhaul Coordinator, *Pacificorp*

Togar MP - TA Refineries Manager, *Pertamina*

Tomas Palma - CEO, *Evraz Nikom*

Marc Van Thillo - Maintenance Manager, *BASF*

Irwan - VP Reliability, *Pertamina*

Tansel Kutmen - HSE Team Leader, *Enka Power*

Cromwell Cuvalay - Shutdown Manager & Project Manager, *Tata Steel*

Anil Malik - Turnaround Coordinator, *Qatar Petroleum*

Julie Leavitt - Director of Administrative Services, *PacifiCorp*

Attila Szekeres - Turnaround Manager, *MOL Group*

Tony Wilkes - Shutdown Coordinator, *RWE Npower*

Lovat MacGregor - Strategic Account Manager, *Cape Environmental Services Offshore*

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Colin Smalley - Development Manager – Process Diagnostics, *Tracerco*

Nick Brown - Enterprise Asset Management Specialist, *Pipeline Group*

Alan Brodie - Senior Technician & Operations Coordinator, *Air 2 Work*

Johnny Baert - Turnaround Manager, (Shell & Zeeland Refinery), *Independent Consultant*

Edwin Van Doeselaar - Turnaround Manager, (Zeeland Refinery), *Independent Consultant*

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Too many KPI's!

Testing the Value of your Key Performance Indicators

Ben Stevens
DataTrak Systems Inc www.datatrak.ca

How many times have we heard the cry "too many KPI's – which ones should I prioritise?".

Here's a simple method of sorting out the ones that work from the ones that should be junked.

1. First define the major objectives of your KPI's.
2. Next ask some penetrating questions about whether your KPI's match these objectives
3. Then build a simple scorecard (a sort of KPI that measures your KPI's???)

Here are some proposed Objectives of KPI's

- To focus attention on a critical status or trend
- To measure it effectively and promptly
- To quickly identify a key change in the trend or status
- To prompt a change in behaviour
- Easily measured, easily understood, clear unambiguous message

Some skill-testing questions:

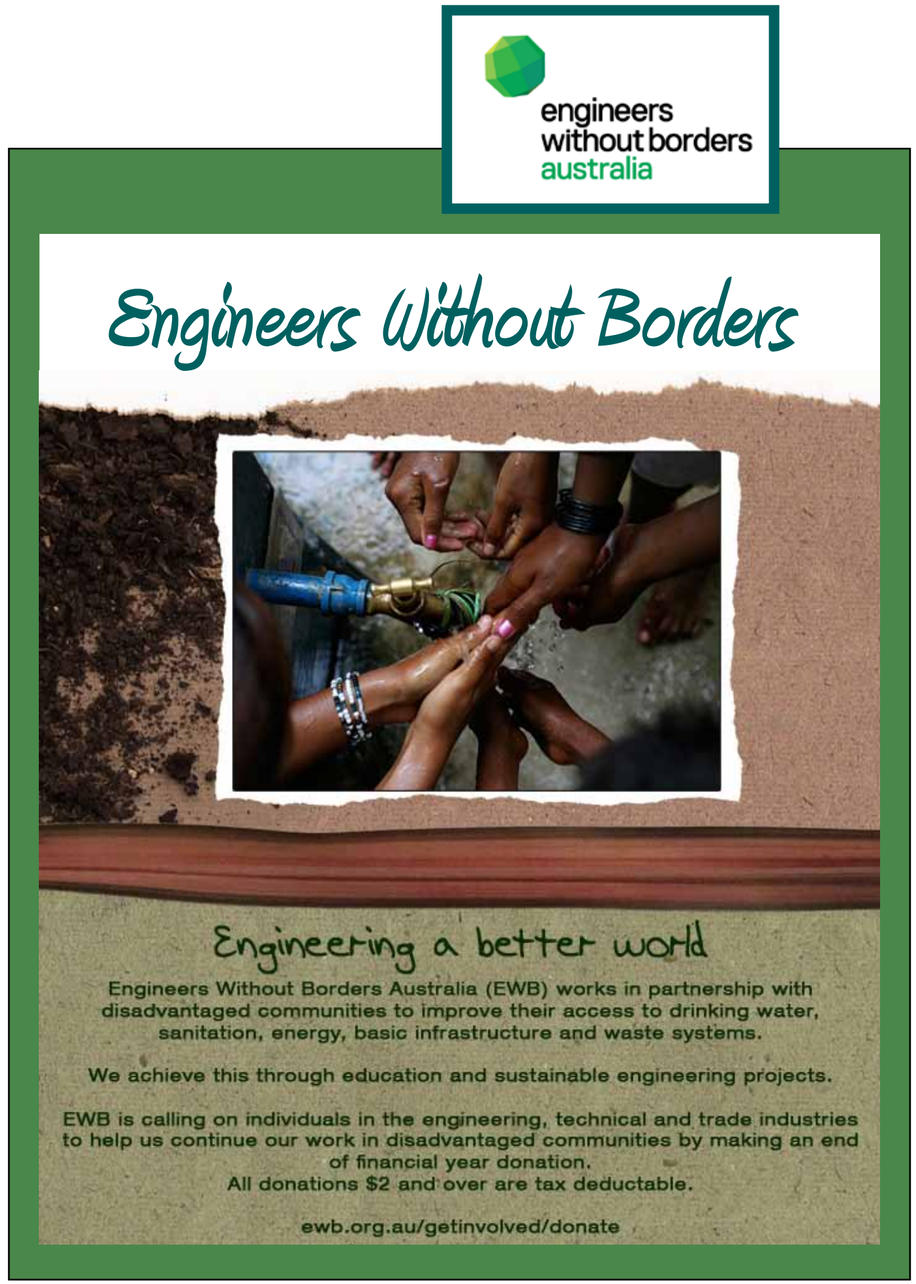
- Is the status or trend really critical to the performance of the user and the equipment?
- Does it have a real impact on the profitability or effectiveness of the organization?
- Does the measurement, analysis & reporting process properly reflect the performance of the equipment?
- Are the results quickly available?
- If there is a change in the status or trend, does this rapidly show up in the KPI?
- If a change in the trend or status does occur, does it prompt a meaningful change in the behaviour of the Maintenance and Operations team?
- Does this behaviour change happen quickly enough to reverse or enhance the trend during the current period?
- Is the measurement and analysis process easy and precise?
- Is the measurement and analysis process well understood by the Maintenance team?
- Is the output message clearly understood by the Maintenance team and by Management?
- Do people read it and use it?

Scorecard

Here's a simple scorecard – set your own objectives and parameters; use your own scoring method; & set your own "junk it" level.

	Critical Trend	Effective measure	Key trend change	Behavior change	Easy to measure, understand	TOTAL

Score each KPI 1 (low) to 5 (high) for its ability to meet the criteria. Anything scoring below 15 should be challenged! stevensb@kingston.net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Spur/External Gear Pump Vibration Awareness

Hamid Malaki VibraHiTec Ltd. UK
www.vibrahitec.com

Introduction

Over many years working in the fields of rotating machinery and analysing Noise and Vibration issues it is still surprising to see that the issue of gear pump vibration comes up over and over again.

Gear pumps are commonly used for pumping lube oil, fuel oil and generally higher viscosity fluids than water. They almost always have a strong vibration component at the tooth mesh frequency, which is the number of teeth on the gear times the RPM.

Generally the amplitude of the gear mesh frequency at higher orders normally starts to reduce/diminish if no gear impact is present. This component will be highly dependent on the output pressure of the pump. If the tooth mesh frequency changes significantly (in comparison with any previous reading) - the sudden appearance of harmonics or sidebands in the vibration spectrum - could indicate a cracked or otherwise damaged tooth and flexible coupling.

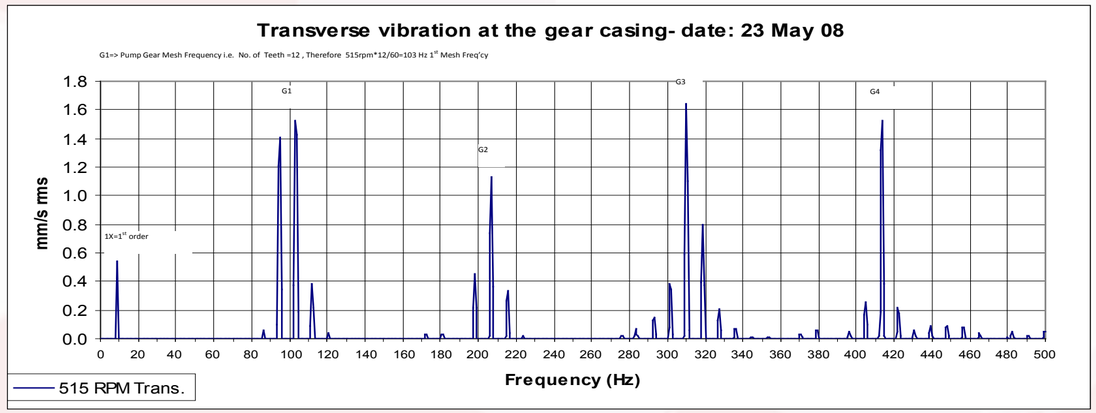
The high vibration in the gear pump, specifically at the gear mesh frequency with the presence of a side band is normally an indication that the generated harmonic torque is greater than the mean torque. The amount of backlash - clearance between the meshing teeth - will have a high influence on the vibration level and its severity.

When designing the gear pump (for a particular application), attention must be paid to ensure that the mean torque is always greater than the harmonic torque. This usually is determined when one does the required analysis.

External Gear Pump Operation

In gear pumps the liquid is trapped by the opening between the gear teeth of two identical gears and the chasing of the pump on the suction side. On the pressure side the fluid is squeezed out when the teeth of the two gears are rotated against each other. The tight clearances (in the order of 10 µm), along with the speed of rotation, effectively prevent the fluid from leaking backwards. The motor provides the drive to the drive gear.

Fig 1. Typical measured spectrum of a External Gear Pump

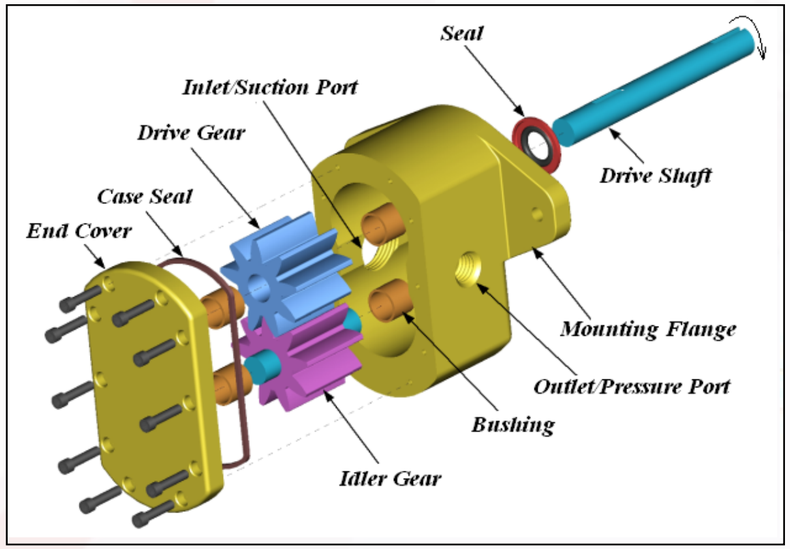

Transverse vibration at the gear casing- date: 23 May 08
G1=> Pump Gear Mesh Frequency i.e. No. of Teeth =12 , Therefore 515rpm*12/60=103 Hz 1st Mesh Freq'cy
mm/s rms
Frequency (Hz)
G1
G2
G3
G4
1X=1st order
515 RPM Trans.

The rigid design of the gears and houses allow for very high pressures and the ability to pump highly viscous fluids. Due to the high pressure in the gear pump usually high pulsation is generated which in most cases creates higher harmonics than the mean torque. The pulsation is usually exacerbated by the clash of the returning pulse in the pipe line. Therefore, design of a pump and its associated components including connection and pipe sizes for a specific application must be carefully considered at an early stage.

In general, gear pumps have served industry well and will continue to do so. But in a wrong application and installation one should expect problems.

If problems arise, then constant vigilance, coupled with a willingness to contemplate a range of possible failure mechanisms rather than grasping the first thing that comes to mind may save a lot of time and expense in the long run. Where there is a design and/or an application issue, one has to admit it, accept the consequences and stop blaming one or the other – or one another! This may also save a lot of time and expense. *The machine will ultimately tell its story…*

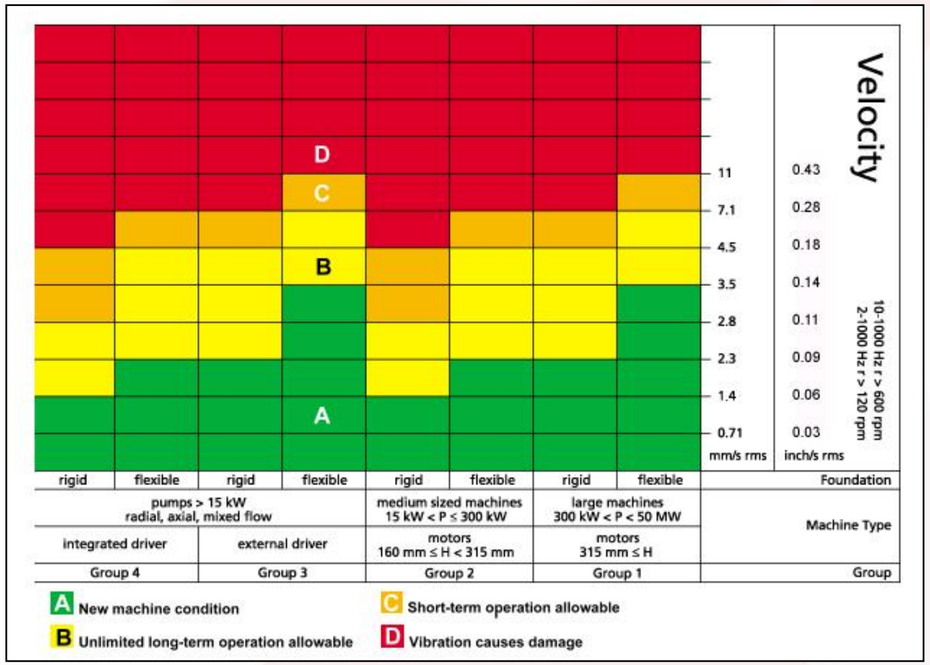
Fig 2. The External gear pump exploded view



Standard Vibration Level

Before discussing pump vibration it's worth noting that vibration acceptability is often subjective - moderated by one's past experience with that particular system or machinery. There are no fixed vibration limits that can be applied to machineries of different types and models since vibration limits can vary from one type to another. Advice on acceptable levels of vibration is given in the ISO standard 2372 (BS4675-Part 1), "Mechanical Vibration in rotating machinery", ISO standard 10816, "Guidelines" and various other standards. It is commonly considered that these levels apply to the main structure of the machinery while attached parts such as fabricated supports, pipe work etc, will be able to tolerate higher levels of vibration as long as the stress levels in the appropriate component are within the material capability and are not exceeded.

Fig 3. Typical vibration limit guideline



The following is a guideline based on ISO Standard 10816 for the evaluation of machine vibration monitoring.

ISO Standard 10816 Guidelines

Evaluation standard for machine vibration monitoring

With those factors in mind, we can now look more closely at the vibration behaviour of a gear pump and its support structure.

The following case study is an example showing the consequence of excessive vibration in a gear pump as a result of high harmonic torque.

Case Study: - Excessive Vibration in a Gear Pump and its Effect

Recently one of our clients reported excessive vibration on two newly installed External Gear Pumps, whose purpose was to pump liquid Polyurethane to a processing unit for the production of Offshore Bending Stiffeners. The vibration has caused concern amongst the operating engineers whom they were not happy to operate these pumps in this state until they find the cause of the vibration and their safety expect. Both operator and pump manufacturer agreed that the vibration seemed to be excessive. They also agreed that the best way to move forward was to; first determine the vibration level and its acceptability level and then contemplate a range of possible solutions when mechanism and cause of this excessive vibration became evident.

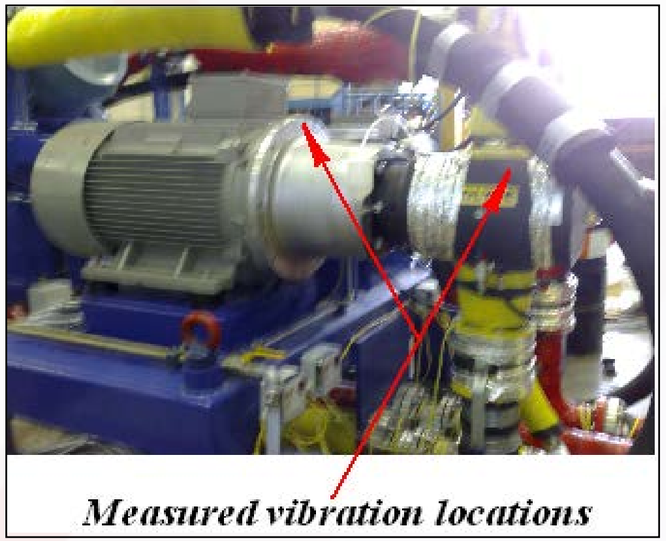
General Observation

At first glance, the installation looked unconventional. The client declared that the pumps had initially been solidly mounted to the structural frame. But due to high levels of structure born vibration the installation method was changed by isolating each pumpset using 5 Anti Vibration Mounts (AVMs). One mount was placed under the pump and one under each corner of the motor feet. This decision had apparently been made by the supplier of the pumps without any vibration measurement. At the same time, flexible connections were introduced between each pump and its inlet and outlet piping.

Initial Investigation

Rather than grasping the first thought that came to mind, based on previous experience with such external gear pump problems an initial, brief linear vibration survey was done. The measurement was carried out at various speeds, at two locations on the gear pump and the motor. This measurement was done to establish vibration amplitude and determine dominant frequencies, pump general operating characteristics and current condition and its acceptability.

Fig 4. The external gear pump and measured vibration locations



The author requested to see the Factory Acceptance Test (FAT) and Torsional Vibration (TV) calculation report before further measurement were taken. Unfortunately, neither the FAT nor the TV analyses were available. This was not surprising, as we have found that many pumpset manufacturers do not include dynamic analysis in their design brief.

Although the vibration measurements could not immediately identify the cause of the problem, their distinctive signature pointed to a harmonic torque being higher than the mean torque, and brought to mind similar measurements made by the author during past investigations of gear pumps problems.
Some other relevant design information was obtained from manufacturer's literature:

General Pump Information:-

- Torque required to operate the pump at maximum output = 509Nm
- Maximum available torque from electric motor at full output (45Kw 8pole motor) = 605Nm
- The coupling is suitable for a maximum torque of 1300Nm

Pump gear details:-

- There are 2 gears in the pump with 12 teeth per gear.
- The length of the gear is 175mm with a 20mm wide key way.

Results

In general no significant pump structural resonances were noticed throughout the pump running range and there was fairly low vibration on the support structure due to the presence of AVMs. Hence there was no reason to concentrate on the support structure. The installed mounts were, however, an afterthought, and were not properly installed. Above all, they were not loaded evenly.

The analysed vibration results showed that the dominant vibration amplitudes were at the gear mesh frequency. At full speed (515 RPM) the 1st order was 8.53 Hz, hence, with 12 gear teeth, the 1st gear mesh frequency would be equal to 12 x 8.53=103Hz which this was evident in the measurement. Other dominant frequencies were at 2nd, 3rd and 4th .order gear mesh frequencies.

While the measured linear vibration amplitudes might be typical of such pumps after a long period in service, for a new machine this was excessive. The maximum measured vibration amplitude at full speed was 5.6mm/s rms at 103Hz (1st gear mesh frequency). Although the vibration could just be tolerated for a very short period of time, but the major concern was the side bands at the gear mesh frequencies. This suggested the presence of gear impact as a result of high harmonic torques. High harmonic torque is indicative of high levels of torsional activities within the pumps and linear vibration measurements alone cannot rule on acceptability. Coupling, shaft and gear damage can occur as a result of torsional vibration without any significant change in linear vibration amplitude almost to the verge of complete failure. Hence to determine its significance, ideally a direct measurement of output torque vibratory amplitude has to be measured but, in this case it was not cost effective and so easy to do so unless ones agrees to do this as a development exercise.

The initial linear vibration survey, though not of itself conclusive, had given us a strong pointer towards what might be the outcome of this investigation. However, stepping back for a moment, we could reflect that those few results and observations had also yielded other clues as to what was and was not happening.

1. If the structural mounting surface is not flat and even, the pumpset base plate can distort or twist. This can compound the natural vibrations that are inherent in any rotating machine making the base plate amplify the vibration. But these pumpsets were isolated and no associated vibration could be identified in association with its mounting – even though that mounting had not been executed correctly.

2. Coupling misalignment or misalignment between motor and pump can also be a contributing factor to vibration. Proper coupling alignment should be checked prior to final start up to be sure it meets the specifications for the coupling. In this case, significant 1st order vibration – characteristic of misalignment – was not evident.

3. Often, piping strain or misalignment may contribute, or be a source of additional vibration. The pumps were however flexibly connected to inlet and outlet piping, which tend to reduce vibration levels. From a vibration point of view, those connectors had effectively isolated pump from piping.

4. A flexible coupling introduced between drive and driven shaft line allows a small amount of misalignment. But its major contribution is to reduce the pump torsional vibratory torque and isolate the drive from the driven system dynamically. The flexible coupling absorbs gear impact loads which might otherwise lead to gear damage and shaft line failure. Where vibratory torque exceeds mean torque, reversal torque is created which causes impact. The strength of this impact is dependent on mean torque, shaft line stiffness, coupling stiffness, gear backlash and its clearance, pump pressure and pressure pulsation. Recalling that the initial measurements seemed to indicate torque reversal, it was clear that the next step in the . investigation was to look for reversed torque, and the first place to start is the flexible coupling. The strength of the torque reversal can usually be assessed by visually checking both sides of the coupling lobes for sign of impact. This subject matter is discussed below in more detail.

5. Recalling the manufacturer's data above lent further credence to the way the investigation was moving. The coupling nominal operating torque was not provided but should generally be reckoned as 1/3 of maximum torque in an impulsive drive situation such as this, but was nearer 1/2. One could use this yardstick and fault the coupling

selection as the main reason for the problem. Although coupling torque capacity was not sufficient but the source of the problem lies within the gear pump and not the coupling alone as demonstrated below.

Flexible Coupling Type;

The vibration results on these pumps indicated medium to high levels of torsional activities within the pumps. It is evident (from the side bands of each order) that the gears were impacting one another. Flexible coupling, shaft and gears are therefore under enormous loads. In these circumstances, coupling heat load capacity will certainly increase beyond its allowable limit particularly where (as in this case) coupling selection appears to have been based purely on the mean driving torque, without allowing an adequate factor of safety for service characteristics. Coupling failure expected to occur at any time as a result.

There are not many industry standards for pump applications that specify requirements for couplings. More importantly, no specifications and requirements do explain how couplings work or help in the selection process.

With the above in mind, the reason for the coupling failure is not usually due to the mean torque but vibratory torque which exceeds the mean torque (sometimes by 3 to 4 times in gear pumps). This will be evident if one removes the coupling and checks both side of the drive lobe. Marking will be noticed on both sides of the lobe which indicates that the vibratory torque is much higher than the mean torque hence the reason for the coupling failure if vibratory torque exceed the coupling limit.

Based on experience gained on these types of pumps it is always advisable to investigate the torsional activities at the design stage in order to avoid pump failure as result of coupling and gear tooth breakage. Consideration of mean torque alone is no way sufficient to select a coupling for a gear pump.

Fig 5. Damages shown to Spidex S42 model Coupling - Coupling damage After Works Test (approximately after 10 hours). The blue coupling is dimensionally similar but of harder material.

There is however no readily available solutions to reduce torsional activity inherent in the operation of a gear pump in most application. You have to live with that vibration, so selection of the correct coupling becomes critical to the life of the pumpset.

In Figures 5 - 9 are some typical examples of failed gear pump couplings.

All failures have accrued as a result of torsional activities due to pulsation and gear impact. But these illustrations also provide caution against the ‘quick fix’ – merely changing the coupling inner member alone does not necessarily provide a complete solution.

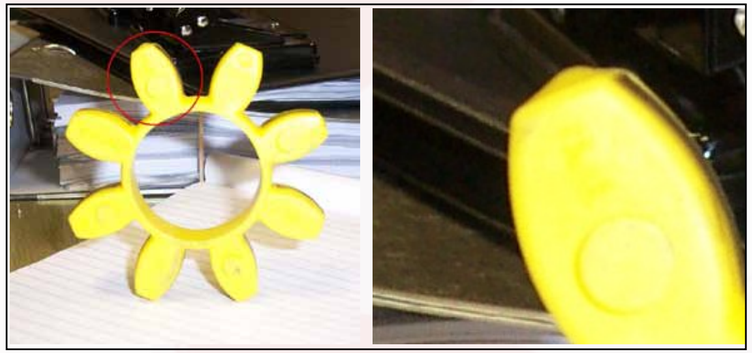


Fig 6. Note The Bulge at the Top on another similar pump after a short run.

Fig 7. Larger Coupling (S48) with higher load capacity used on the high pressure gear pumps to see the effect. Coupling Shown After 3000 hours Running.

Fig 8. The same gear pump using a different type of coupling. Coupling (finger type) show some sign of wear but with slightly better performance. Running hours not available but believed to be more than 1000 hours. Note the whitish powder dust in the bell housing as result of coupling wear.

Calculated coupling safety factors based on mean torque (not the maximum torque);

S42 = 1.3 S48 = 1.5

J. Finger type = 2.4

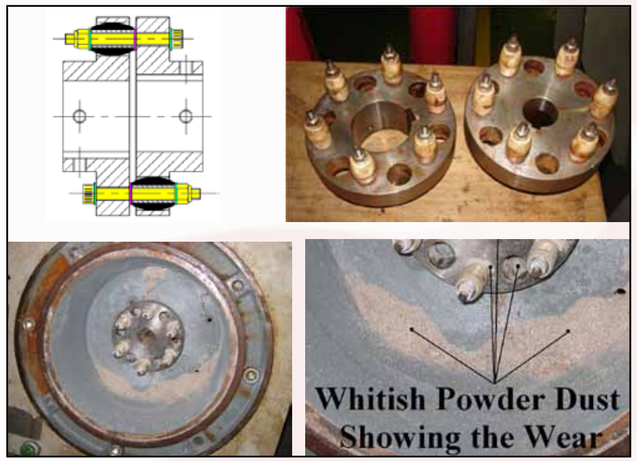
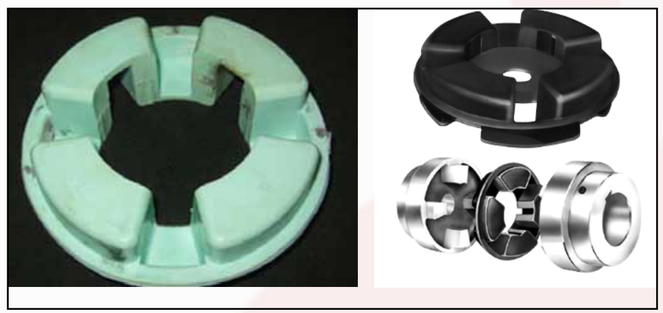


Fig 9. Different (MAG) type coupling on a similar pump after 1000 hrs; No vibration measurement is available. This coupling seems to be performing better but there is no long term running data yet available.



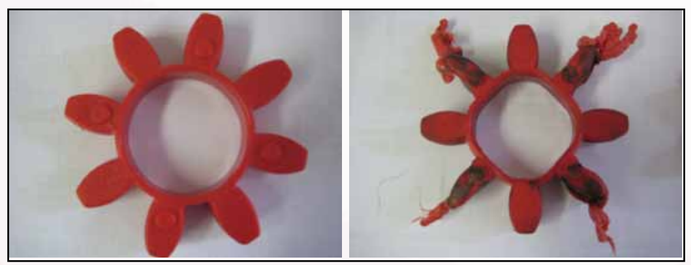
With this coupling it is believed that under loaded conditions, the resultant forces applied on the element segments are evenly distributed in the compressive direction only. This results in no radial forces to multiply the internal heat generation. It should be noted that more running hours is required to determine its suitability. By no means is it intended to imply that this coupling is better or worse than the others but to provide results of some previous investigation.

Important Note:-

The illustrations above are intended to give a broad view of some of the things that can go wrong with couplings on gear pumps, and to show that solutions to such problems are rarely arrived at easily. The main thing to bear in mind is that the enemy - torsional activity generated by the pump – cannot easily be eliminated, but its effects might be mitigated by proper selection of coupling.

The client was advised to remove and check the coupling, the tell tale signs of torsional failure were immediately evident. The client rather than going for trial and error in finding a possible temporary solution by changing coupling, decided to change the pump in its entirety and select a screw type pumpsets.

Fig 10. Running hours to failure, less than 100 hours. The failed coupling continued to run at a slower speed for another 600 hours.



Conclusions

1). Although the linear vibration on the External Gear Pump carcass could be considered within an acceptable level of itself, the vibration pattern was giving clues to a more destructive mode of vibration – torsional – occurring, less obviously, within the rotating assembly.

2). Anti Vibration Mounts have a significant effect in reducing structural vibration but they do need to be correctly installed.

3). Signs of distinct Noise and Pulsation plus the side bands at gear mesh frequency indicates the possibility of medium to high level Torsional activity.

4). It is advisable to repeatedly remove and check the coupling for evidence of torsional vibratory effects on a new installation early in its service life, particularly when torsional measurements cannot easily be taken. In this case, the check would be for marking on both sides of the coupling drive lobes.

5). There is no readily available solution to reduce Torsional activity on external gear pumps. If a suitable coupling cannot be selected for a particular application, a change to something completely different e.g. a screw type pumps might be necessary.

6). The purpose and application of external gear pump must be fully investigated before selecting these type of pumps. External gear pump on certain applications will be troublesome.

7). Cavitation can sometimes play a part in pump failure. This can sometimes be picked up by vibration measurement; there was no sign of cavitation on the measured results from the above case study.

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Add Another Dimension to Your Machine Vibration Monitoring Using Wireless Headphones with Bluetooth for the CSI 2140

Reliability engineers know that listening to bearings or gear-teeth during machine operation can help diagnose machine problems. Wearing headphones to listen to machine vibration through the accelerometer gives another dimension and sense to what is happening with the machine.

The CSI 2140 Machinery Health Analyzer offers a wireless headphone solution that takes advantage of Bluetooth technology. Even users in harsh industrial environments (where hearing protection and hardhats are required) can take advantage of this easily-adaptable accessory.

Overview

Machines communicate information about their condition in many ways. No technician or analyst wants to miss those cues and overlook a machine fault or call one that does not exist. With the right equipment, you can truly listen to what machines are telling you. Every tool at your disposal can help when analyzing a machine.

A high-quality portable vibration analyzer, such as the CSI 2140, helps uncover machinery issues so they can be addressed before problems (and associated costs) impact production. Listening to vibration as data is gathered can add a level of confidence during diagnosis.

Reliability engineers know that listening to bearings or gearteeth during machine operation can help diagnose machineproblems. Wearing headphones to listen to machine vibration through the accelerometer gives another dimension and sense to what is happening with the machine. Because the headphone wire can be cumbersome and can pose a safety risk, technicians often ignore this analysis opportunity.

The CSI 2140 Machinery Health Analyzer offers a wireless headphone solution that takes advantage of Bluetooth technology. Even users in harsh industrial environments (where hearing protection and hardhats are required) can take advantage of this easily-adaptable accessory.

Listen to What Your Machine is Telling You

Using headphones with the analyzer, a technician can listen to the vibration signal, look at the digital data as it is gathered, and make notes about the sounds and how they correlate to the data and vibration signature seen.

The technician can verify if something is heard and seen at that same time. For example, if the tech sees a vibration in low amplitude and hears nothing, he can discount the vibration as not an immediate concern. But if the tech sees a low-amplitude vibration and clearly hears vibration, the machine might need to be examined more closely or monitored more frequently.

Not only can the technician listen live to the sounds, but he can also use AMS Machinery Manager software to playback the waveforms as audio files for further analysis. The audio file playback can be correlated with the vibration waveform patterns to support diagnosis.

The benefits are many:

- *Certainty of connection.*
  Hearing the sound of vibration, the technician can be sure that the sensor is properly functioning and is mounted correctly on the machine being analyzed.
- *Obtaining better measurements.*
  If the technician hears an interesting vibration coming from the machine, he can obtain a better vibration measurement by:
  - Moving the sensor on the machine until he hears the sound much louder or clearer before collecting the vibration measurement.
  - Adjusting the maximum frequency setting on the vibration analyzer to make sure the sound he is hearing is captured in the vibration measurement.
- *Comparing good and bad.*
  To compare and assist with analysis, the technician can record waveforms from identical machines. For example, the tech can obtain a waveform recording from a machine with a good bearing and one with a bad bearing and replay those waveforms as audio files in AMS Machinery Manager for comparison.

- *Catching elusive issues*.
  The technician can listen for any transient noise, such as a single broken tooth, which might not appear or be easily seen on the waveform spectrum.
- *Focusing on the issue.*
  Headphones enable the technician to focus completely on the machine rather than muffle the machine by using earplugs.

There is no doubt that listening to vibration can add value to route-based analysis. But headphone cords that attach to a handheld analyzer can become a nuisance. Even more serious, however, cords can present a safety risk by catching on machinery and endangering both the technician and the process.
Emerson offers a solution that enables you to obtain all the benefits of headphones without the hazards.

The CSI 2140 solves the headphone-cord problem by communicating via Bluetooth to wireless headphones. In many cases, industrial settings pose unique requirements for the use of headphones - all requirements are met by the CSI 2140 solution.

For example, many industrial environments demand that headphones: • Protect hearing • Be worn with a hardhat

In addition, to ensure that the complete range of machinery sounds can be heard (up through the 20000 Hz range), Emerson has chosen the A2DP Bluetooth profile for use with the CSI 2140.

Start Listening and Start Improvements

When you begin your listening program associated with route-based analysis, you will find it becomes an essential part of your machinery health program.
As an Emerson customer recently mentioned to us “The fact is: Today, none of my vibration techs would do a route without headphones.”

http://www2.emersonprocess.com/en-US/brands/csitechnologies/pva/CSI2140/Pages/CSI2140.aspx

How to Use A Grease Gun

Noria Corporation has released a “How to Use a Grease Gun” video tutorial for those who would like to further their expertise in the areas of grease application and proper lubrication methodology.

One of the newest additions to Noria’s Reliable Skills Training video series, “How to Use a Grease Gun” is designed for lubrication professionals and manufacturers. The set includes a 28-minute DVD and comprehensive student workbook providing easy, how-to methodologies to ensure grease gun best practices.

Featuring a DVD and comprehensive booklet, the new release provides step-by-step foundational training that covers how a grease gun works, the best practices for loading a grease gun, the risks of mixing different grease types, the differences between various grease gun models, how to avoid grease contamination, how to use grease guns safely, how to get the most from your grease gun, and why proper grease lubrication is important to machine reliability.

“The grease gun is one of the most widely used tools for machinery lubrication, yet few are trained on grease gun best practices,” said Noria Corporation CEO Jim Fitch. “When used or loaded improperly, the grease gun can become a safety risk to both the lubrication technician and the machine.”

The DVD and student workbook retail for $395.
www.noria.com

ABB signs $33 million service contract with QGC

ABB has signed a long-term service agreement (LTSA) with QGC, a wholly owned subsidiary of BG Group, to provide planned and unplanned maintenance for the up- and mid-stream facilities at Queensland Curtis Liquefied Natural Gas (QCLNG). The project, located in Queensland, Australia, is the world’s first to convert gas from coal-seam into liquefied natural gas.

Coal-seam gas is natural gas extracted from coal beds. It provides the same amount of energy as coal, but carbon dioxide emissions are 40 percent lower. QCLNG is a priority project for QGC because it involves expanding exploration and development in southern and central Queensland. The upstream facilities stretch across the Surat Basin, where the coal-seam gas is gathered and transported along a 540-kilometer underground pipeline, to the LNG plant on Curtis Island near Gladstone. The contract value is $33 million over four years, with potential for extending the service term up to a period of 10 years. ABB is to provide comprehensive services including an on-site team to maintain ABB’s Extended Automation System 800xA Integrated Control and Safety Systems (ICSS). The contract also covers spare parts management for QCLNG’s upstream collection and transportation facility as well as for the midstream liquefaction and export facility.

“This important contract affirms our strong and long-standing relationship with QGC, which is one of our key customers,” said Axel Kuhr, country manager for ABB in Australia. “We are proud to continue working for this important oil and gas project, and one of our key priorities will be to help our customer reach its production targets in a flawless way.” www.abb.com

Maintenance & Reliability **News**

Swedish fan supplier Solyvent Fläkt invests in the latest CM technology from SPM.

The portable instrument Leonova Diamond®, containing the patented measuring technique SPM HD® and vibration analysis, and the multifunctional Intellinova® online system will now be part of the company's portfolio of tools for condition monitoring.

The portable instrument Leonova Diamond will be used by field service personnel for troubleshooting and analysis of ventilation systems. Utilizing the same measuring techniques, the Intellinova online system will be used for final inspection of ventilation systems prior to delivery to the customer to ensure plant performance as well as for research and development of new fan assembly.

Henrik Marken, Project Manager, says: 'Having compared four suppliers, we chose SPM. One important thing for us was that the products be user friendly, and this is a hallmark of SPM products. The low weight of the Leonova Diamond makes it easier for our service technicians when traveling around the world with the instrument. Leonova Diamond and Intellinova both offer the functionality we need, with vibration analysis and shock pulse measurement combined in the same device.'

Solyvent Fläkt AB is part of the Fläkt Woods Group and a leading global provider of process fans, primarily for light and heavy industry and infrastructure projects.

The company offers a wide range of axial fans for the management of flue gases as well as for pure applications. Its products are ATEX certified for use in explosive environments, suitable for high operating temperatures and provide many options for high system pressures

www.spminstrument.com info@aptgroup.com.au www.aptgroup.com.au

New Electronic Light Makes Troubleshooting More Efficient for Plant Maintenance Technicians

Inspired by the bold, unconventional design of the WorkStar 2000 Technician's work light, the Hunter's Floodlight can also be used "hands-free" and offers a unique combination of features. These include a moveable, directional light head with two brightness levels, and a choice of mounting options including powerful, integral rare earth magnets, retractable hook or tripod mount. The light is rechargeable, with a run time of up to eight hours and uses a single, high output 270 lumen light-emitting diode (LED) as the lighting source. The LED is virtually unbreakable and has a life expectancy of 50,000 hours.

A critical element of the light's design is the beam pattern architecture that is common to all Maxxeon lighting tools. In contrast to most flashlight beam patterns, the wide-angle, floodlight-style beam pattern produced by the Maxxeon light has been designed to be completely uniform and free from the dark spots or hot spots.

This clear beam pattern is achieved using an intense white light, and results in the user being able to see clearly, and easily distinguish features and colors within the beam range. This ability to see the field of view clearly and precisely is an obvious advantage to plant maintenance personnel when inspecting and troubleshooting.

For more information visit the website -
http://www.maxxeon.com/led_hunters_worklight_workstar_2030.html

New Fluke VT04 Visual Infrared Thermometer's sharper resolution detects issues instantly

Fluke Corporation introduces the Fluke® VT04 Visual Infrared Thermometer, the latest troubleshooting tool with built-in digital camera and thermal heat map overlay that bridges the gap between traditional IR thermometers and infrared cameras.

It is the ideal frontline troubleshooting tool for electrical, industrial maintenance, HVAC/R, and automotive applications.

The ultra-compact Fluke VT04 is fully automatic with built-in intelligence so issues can be detected instantly with no training required.

The VT04 includes alarm features never seen before on entry-level infrared cameras for stubborn intermittent issues including:

* hi-lo temperature alarm that flashes on the screen if the user-selected temperature is exceeded
* time-lapse image capture that can be set to capture images in 30-second to one-hour intervals
* an auto-monitor alarm that initiates image capture automatically after a temperature alarm has been triggered letting users automatically capture images, even while the VT04 is unattended, using the universal tripod mount.

It displays and saves images as full digital, full infrared or in three blended modes (25, 50, and 75 per cent) with a 40 per cent wider field of view than the VT02. Markers pinpoint hot and cold spots indicating the hottest and coldest temperatures on the screen. A temperature reading is provided at the centre point. Images are saved to the included micro-SD card, eliminating the need to write down single or multiple measurements. The VT04 Visual IR thermometer also has a rechargeable Li-ion battery.

Images from the VT04 can be imported into the included SmartView® analysis and reporting software to produce professional reports that document problems detected or repairs made for management and customer review.

sales@fluke.com.au www.fluke.com.au

Contactless Vibration Measurement For Condition Monitoring

The introduction of a contactless method of measuring vibration in the form of the SKF Laser Vibrometer MSL-7000 has significant implications for both condition monitoring and production quality testing. Developed in cooperation with Polytec GmbH in Germany, this small, compact and easy-to-install unit extends the assortment of sensors for use in condition monitoring.

It has already been employed by SKF for noise-testing applications in its own bearing manufacturing. The SKF Laser Vibrometer can be connected with SKF noise-testing technology for advanced end-of-line testing installations for other types of equipment, such as electric motors, pumps and compressors, thus opening the technology to other companies.

The new sensor was developed to be used together with SKF condition monitoring products. The SKF Laser Vibrometer can be combined, for example, with the SKF Microlog (see image), thus offering additional value to all customers. This opens up more potential applications with SKF portable instruments and online monitoring systems, while also giving SKF service engineers an advanced and flexible tool for mobile vibration measurements in a large number of different field applications. These measurements include:

- measuring ranges of 20 mm/s, 50 mm/s,100 mm/s
- velocity proportional signal available on digital (sp-DIF format) or analogue output connector
- acoustic measurements from 0.2 Hz (for slow rotations) up to 22 kHz
- measurements over large distances (up to 3 m)
- measurements on hot surfaces
- measurements of vibration on rotating parts
- consistent signal, with no influence of force applied to the piezo
- measurements in hazardous zones or areas that are difficult to reach
- measurements through glass

The MSL-7000 features a robust, compact design in a single unit that is easy both to install and to operate. It employs non-contact measurement and thus is reliable and free from wear.

From a safety perspective the product incorporates an eye-safe, visible, low-power laser (Class II).At the heart of each SKF Laser Vibrometer system is a laser-Doppler vibrometer (LDV) – a precision optical transducer used for determining vibration velocity and displacement at a fixed point. The technology is based on the Doppler effect: sensing the frequency shift of backscattered light from a moving surface.

www.skf.com www.polytec.com

TC7000 - the World's First Fully Radiometric, ATEX & IECEx Certified Intrinsically Safe Thermal Imaging Camera

The market has been asking for an intrinsically safe thermal imaging camera for use in hazardous areas within several industry sectors owning explosive environments including: Oil & Gas, Mining, Petrochemical, Pharmaceutical, Food Processing, Aviation and Marine.

Recent studies have shown that to raise a hot work permit - required when non-certified devices are used within hazardous (explosive) areas - can cost companies up to $600USD per permit. An intrinsically safe thermal imager, removes the need for hot work permits as it is certified (ATEX and IECEx) to operate within explosive areas safely, enabling more efficiencies as well as reducing the cost of inspections.

"The release of the TC7000 is particularly exciting when you look at the potential for new levels of safety, accuracy and efficiency offered to personnel performing IR scans on equipment while working within hazardous areas. An intrinsically safe, fully radiometric, infrared imager simply did not exist and we committed to creating a device that is highly accurate, lightweight (under 3 lbs), safe to operate, efficient, and comes standard with the latest features available in imaging devices today,"states Tony Holliday, Managing Director, CorDEX Instruments Ltd.

TC7000 is a fully featured, handheld thermal imaging camera and is ATEX and IECEx certified for the use in Zone 1 hazardous (explosive) gas, dust, and mining environments. The TC7000 can measure temperatures up to 600C and reference each individual stored image to an RFID tag using its onboard RFID scanner. It boasts a full color screen and thousands of fully radiometric files can be stored easily with 8GB of onboard memory and downloaded via USB into the cross platform report and database software provided free-of-charge with every camera.

Contact Applied Infrared Sensing www.applied-infrared.com.au

New Fluke ClirVu CV Series IR Windows offer ultimate protection for inspectors of high-energy equipment

With an installation time of five minutes or less, there's no need to sacrifice safety or compliance to take infrared camera readings

November 26, 2013 – More than 99 per cent of all arc flash incidents occur when a panel door is open, exposing workers to potentially lethal amounts of energy. The new Fluke® ClirVu CV Series IR Windows eliminate the need to open the panel door to take infrared camera readings, and with an installation time of five minutes or less, there's no excuse not to protect workers' safety.

The ClirVu CV Series offers the ultimate protection for the electricians, engineers and inspectors who work around high-energy equipment. They are Torture Tested™ to the highest arc blast test ratings and, when properly installed, maintain a panel arc test rating of up to 63 kA.

Once installed, there's no need to power down or remove panels. Inspections can be conducted quickly, easily, and safely often with little, if any, personal protective equipment.

Installation takes one technician five minutes or less. Simply lockout-tag out, punch one hole with a standard conduit punch without removing the panel door, attach and secure the cover. The AutoGround™ feature instantly grounds the IR window to the metal enclosure, eliminating the need to separately ground each metal component of the window.

The hinged cover is easily opened with a quarter-turn latch or key to perform infrared inspections. It also protects the window from accidental exterior impact.
www.fluke.com.au mail sales@fluke.com.au

Certified for Use in Hazardous Areas

Monitran introduces ATEX and IECEx Group II certified intrinsically safe dual output sensors for vibration and temperature monitoring

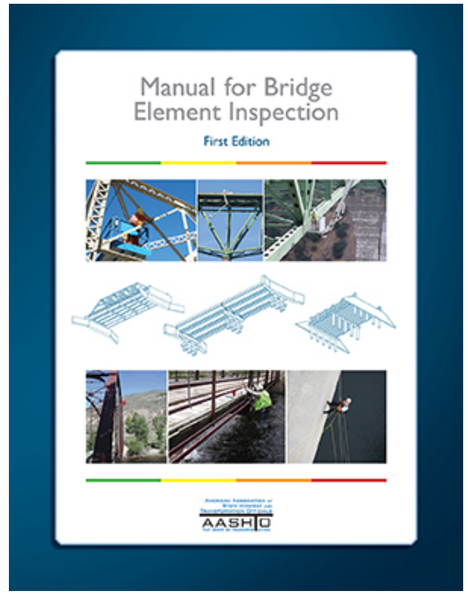
High Wycombe, United Kingdom – Monitran, an industry leader in the development and manufacture of transducers, has launched two series of intrinsically safe sensors. Certified to ATEX and IECEx Group II, the MTN/2285IT and MTN/2200IT series are sealed to IP67, are available with integral cables or 4-pin connectors and are ideal for measuring vibration levels and temperatures in areas where explosive gases, liquids or dust may be present.

Intended for monitoring applications, the MTN/2285IT series comprises sensors with DC current outputs, in the range 4-20mA, proportional to RMS velocity (mm/s) and temperature as a voltage at a sensitivity of 10mV/oC. In addition, the operating temperature is certified to T6 (-55oC ≤ Ta ≤ +45oC).

The MTN/2200IT series is aimed more at analysis applications and features constant current accelerometers with isolated outputs for acceleration, in volts at a standard sensitivity of 100mV/g, and temperature at a sensitivity of 10mV/oC. The operating temperature for this series is certified to T4 (-55oC ≤ Ta ≤ +95oC).

Andy Anthony, Managing Director of Monitran, comments: "The monitoring of both vibration and temperature levels is at the heart of many predictive maintenance strategies. Adding a temperature measuring capability to our existing range of ATEX-certified sensors is a goal we've had for some time as, for instance, we understand most engineers view temperature as the foundation for bearing monitoring. Having put our robust dual-output sensors through the rigorous ATEX and IECEx certification processes, we're able to provide our customers with a variety of products to meet their monitoring requirements in hazardous areas."

MTN/2200IT and MTN/2285IT datasheets are available for download from www.monitran.com



Manual for Bridge Element Inspection, *1st Ed*

This publication is designed for use by state departments of transportation and other agencies that perform element-level bridge inspections. This manual is a reference for standardized element definitions, element quantity calculations, condition state definitions, element feasible actions, and inspection conventions. Its goal is to capture the condition of bridges in a simple, effective way that can be standardized nationwide, while providing enough flexibility to be adapted to both large- and small-agency settings. The information contained in this manual supersedes the AASHTO Guide to Commonly Recognized Structural Elements, 1st Edition and the AASHTO Guide Manual for Bridge Element Inspection, 1st Edition.

Non-Member Price: $192.00 * Member Price: $160.00
https://bookstore.transportation.org

Olympus introduces the IPLEX RX & IPLEX RT industrial videoscopes

With the introduction of the IPLEX RX and IPLEX RT industrial videoscopes, Olympus, a world leader in remote visual inspection technologies, is entering a new era of image quality thanks to advanced image processors and LED illumination systems. Also boasting a compact and robust design, these instruments are valuable assets for inspectors looking for superb image reproduction in difficult applications.

The unique PulsarPic™ image processor greatly enhances image quality and increases the efficiency of detecting tiny defects. It reduces noise and sharpens images to produce exceptionally high-resolution images in low-light conditions. The new LED illumination system is nearly twice as bright as conventional videoscopes and dynamically adjusts light output to reduce halation from reflective surfaces.

The IPLEX RX also offers WiDER™ (Wide Dynamic Extended Range) image processing capability. WiDER enhances detail in shadowed and highlighted areas to produce bright, contrast-balanced images across the entire depth of field. The user-selectable colour and sharpness settings allow images to be customised to suit any application.

The IPLEX RX and RT have compact designs for use in the field. Their 6.5-inch screens have an anti-reflective daylight-view monitor, allowing accurate inspections even in direct sunlight. They are ideal for locations with limited operator access including boilers, aeroplane fuselages and engines, and wind turbine gear boxes.

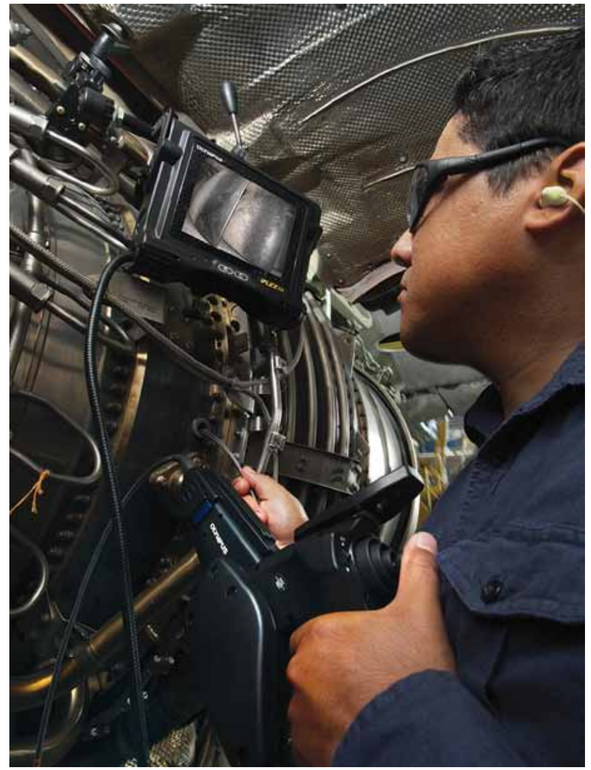
The RX and RT models provide rugged durability in harsh environments. They have an International Protection Rating of IP55 and comply with stringent US military standards for dust and rain resistance, as well as drop testing.

Ergonomic, lightweight handsets feature quick-access buttons for most operations as well as the Olympus power-assist TrueFeel™ scope articulation control. An intuitive icon-based menu system allows quick and accurate selection of the right menu option.

Post-inspection tasks and data transfer are also simplified. The latest IPLEX models feature high-quality JPEG images and AVI movies that record directly to a removable USB flash drive. Images can be saved or retrieved with a single button press, and the thumbnail view allows instant review of inspection results. The instruments' standard InHelp inspection-assist software streamlines data and organises stored images to further improve workflow.

The IPLEX models provide the latest technology in videoscope instrumentation, in line with the Olympus tradition of keeping operators at the cutting edge of non-destructive testing.

http://www.olympus-ims.com



Inspecting turbine blades with an Olympus iPlex RX

The robust design of the iPlex RX meets military specifications for water intrusion

The compact, lightweight design makes the iPlex RX highly portable

Upgrading Maintenance Module In Maximo

ARMS Reliability provides the Asset Management guidance for a Maximo upgrade with a major water utility in Melbourne, Australia. There are many elements to the process that is worth considering if your own organisation is undergoing the same type of project.

The first step was to create the KPI's and calculations that the maintenance department will be measured against. This is important to ensure that these goals align with the overall organisations objectives. It also dictates the minimum fields that need to be designed into the new CMMS system if they are not available with the out of box solution.

A large portion of the time on the project has been to create the business case to support the continuation or elimination of maintenance tasks that have been with the organisation for many years. It was in a sense a cleanse of all data prior to the migration into the new Maximo system. As part of the process the Failure, Cause, Remedy (F-C-R) sets where created for job plan creation and failure history recording. Also in line with achieving best in class planning effectiveness the project defined the resource requirements to complete a job.

An important output of the project was to identify all the assets and systems of the facilities and define an effective hierarchy to allow a logical drilldown ensuring easy navigation by Maximo users and efficient work management.

Important things to consider when undergoing a CMMS migration

- What you are doing today and what might happen in the future – No glass ceilings
- Need to look at data as being able to slice and dice many different ways – Ironing out the rubix cube
- Functionality of Maximo and the use of meters to provide condition history
- Visibility and readiness of hierarchy and related F-C-R sets.

Mitigation of Risks with these types of projects

- Use of tools to ensure that data migrates between systems consistently & reduces need for continual database review
- Involvement of all stakeholders through facilitation ensures widespread buy in.
- Ensures no asset is left out as part of the process. Typically a migration project captures only 60% of a corporations assets.
- Identification of areas that expose the business.

What drops out as part of the process

- Setup of Causes from F-C-R sets represents a useful fault finding guide.
- Load sheets for data migration
- Asset management plans for asset types
- Structure to enable the end user to continue to optimise maintenance strategies.

www.armsreliability.com

Fluke 568 Ex Intrinsically Safe Infrared Thermometer

Fluke 568 Ex Intrinsically Safe Infrared Thermometer delivers accuracy and safety in hazardous environments anywhere in the world . Multinational companies can now standardise on one IR thermometer for operations globally

Fluke introduces the 568 Ex Intrinsically Safe Infrared Thermometer, the only IR thermometer to carry certifications from all major safety evaluation agencies, so multinational companies can use one tool across all their global operations. The 568 Ex is ideal for use in potentially explosive environments like oil and gas, petroleum, chemical processing and pharmaceuticals where adherence to safety procedures is imperative.

The Fluke 568 Ex meets intrinsically safe certifications from all major global agencies for Class I, Division 1 and 2, or Zone 1 and 2 hazardous environments. It measures temperatures from -40 to 800 degrees Celsius (-40 to 1472 degrees Fahrenheit), with a 50:1 distance-to-spot ratio for accurate measurement from a distance and can capture up to 99 points of data.

The rugged 568 Ex's emissivity can be adjusted via a built-in table of common materials or manually from 0.10 to 1.00 in 0.01 increments. Advanced features are easily accessed with soft keys and graphical display.

The IR thermometer comes complete with a K-type thermocouple bead probe, conductive hard case for carrying into hazardous areas, user's manual and safety instruction sheet. Fluke Corporation www.fluke.com.au.

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Maintenance & Reliability **News**

Virgin Galactic Goes Live With Ultramain M&E and Mobile Electronic Logbook Software

Ultramain Systems has announced the go-live of ULTRAMAIN® v9™ software at the world's first spaceline company, Virgin Galactic. Virgin Galactic went live on the entire ULTRAMAIN M&E/MRO product suite, including ActionGraphix™, ActionAnalytics™, Mobile Mechanic™ and Mobile Inventory™, as well as efbTechLogs™. This go-live marks a number of first-ever events for both Virgin Galactic and Ultramain Systems.

According to Mark McCausland, President of Ultramain Systems, "Virgin Galactic is on the cutting edge of aerospace technology and achievement. Working with them has been an incredible experience. We are of like mind in our desire to expand the envelope of paperless operations through the use of well thought-out software. The software in use by Virgin Galactic is the most sophisticated collection of ULTRAMAIN applications produced to date and will be an integral part of the space tourism operations."

In addition to being the first to offer commercial space tourism, Virgin Galactic is the first spaceline to implement commercial grade Maintenance and Engineering software. "We are honored that our software (ULTRAMAIN M&E) is a part of that distinction," McCausland added. The Virgin Galactic go-live constitutes several other firsts including the first operational use of an electronic logbook (ELB) on a mobile device and the first operational mobile ELB integrated with an M&E system. Virgin Galactic is also the first user of the paperless Mobile Mechanic and Mobile Inventory software.

"This is an exciting time for us," said Justin Daugherty, Space Operations Maintenance Control Coordinator for Virgin Galactic. "ULTRAMAIN software is allowing us to operate at the highest level of visibility, safety, and compliance for our operations. In addition, with ULTRAMAIN, Virgin Galactic is leading the way in developing a paperless spaceline operations environment."

Mark Butler, Virgin Galactic Project Manager for Spaceport America said, "Ultramain Systems is a global company that is based in New Mexico. We take pride in working with a New Mexico business that provides the best-in-class software that will be running our maintenance operations."

For more than 30 years, Ultramain Systems has provided superior M&E/MRO software products and professional software implementation services to leading aviation companies worldwide. Their flagship product, ULTRAMAIN®, is a comprehensive airline maintenance and logistics solution that has been refined and enriched through years of collaboration with Ultramain Systems' customers.

Their innovative product, efbTechLogs™, replaces aircraft paper flight logs with an easy-to-use, touch-screen interface that speeds communication between cockpit crews and ground maintenance crews. Web-based, secure, and supporting the latest communications protocols, efbTechLogs enables faster turnaround times, so aircraft spend more time in the air and less time on the ground.

www.ultramain.com sales@ultramain.com

IRISS Reveals CAP-4-US Combination Infrared Window/Ultrasound Port

IRISS has announced the addition of a combination infrared (IR) window ultrasound port product, the CAP-4-US protected by an Unconditional Lifetime Warranty. As their newest innovation, the CAP-4-US enables companies to efficiently detect electrical faults before running into failure.

"As a mission-critical resource, electrical assets must be continually monitored to prevent failure which can cost companies thousands to millions of dollars in loss due to damaged equipment from arc flash or electrical fire, production downtime, personnel injury, and so on," said CEO, Martin Robinson.

"IRISS R&D recognized the industry need for a PESD that leverages a multi-technology approach for electricians to find failure points in critical electrical assets such as transformers and switchgear," continues Robinson.

Many electrical failures are caused by gradual degradation of equipment such as insulators, switches, and connectors. In many cases, the electricity flow is partially interrupted by the breakdown of the circuit.

Early on, these electrical faults can produce noise that is detectable in the 40 KHz frequency range of ultrasonic data collectors, and may also produce heat, depending on the type and severity of fault. The IRISS CAP-4-US makes detecting these electrical faults safer and more efficient.

Several major OEMs throughout the United States and Canada are among the first to adopt the IRISS CAP-4-US.

IRISS IR windows allow for safer, more efficient electrical inspections. IRISS is the manufacturer of the world's first and only, industrial-grade IR windows capable of meeting OSHA's NFPA 70E requirements for arc flash safety.

For more information, visit www.iriss.com.

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Bentley Announces Winners Of The 2013 Be Inspired Awards

Bentley Systems, provider of comprehensive software solutions for sustaining infrastructure, has announced the winners of the 2013 Be Inspired Awards.

The awards honor the extraordinary work of Bentley users improving the world's infrastructure. They were presented at a ceremony during The Year in Infrastructure 2013 Conference, held 29-31 October in London.

During the awards ceremony, 22 Be Inspired Awards winners and nine Be Inspired Special Recognition Awards winners were acknowledged.

Six independent panels of jurors, comprising accomplished Bentley users and distinguished industry experts, selected the Be Inspired Awards winners from 65 project finalists. These finalists had been previously chosen from submissions by more than 300 organizations in 43 countries.

Candidates for Bentley's Be Inspired Special Recognition Awards were selected by the jurors from the top finalist projects as well as other exemplary nominations. The nominees were then reviewed by a panel of Bentley executives, who evaluated them based on the criteria established for each award.

Bentley Systems CEO Greg Bentley said, "I thank and congratulate this year's award winners, along with all of our nominees, for their important contributions to sustaining our society, our environment, and global economic growth."

Bentley Systems has posted highlights of this year's winning projects on its website and has include detailed descriptions of all nominated projects in the print and digital versions of The Year in Infrastructure 2013, To also review past editions of this publication, which together feature more than 2,000 world-class projects recognized in the Be Inspired Awards program since 2004, visit www.bentley.com/yearininfrastructure.

The Be Inspired Special Recognition Awards winners for 2013 are as follows:

Sustaining Our Society

Henan Water & Power Engineering Consulting Co., Ltd – Shahe Aqueduct Project – (Pingdingshan, Henan, China)

Sustaining Our Environment

Kursk Power Station and JSC Neolant – Information Support System for Decommissioning Kursk Nuclear Power Plant – (Kurchatov, Kursk Region, Russia)

Sustaining the Professions

SNC-Lavalin – (Montreal, Quebec, Canada)

Attaining Return on Innovation

Kellogg Joint Venture Gorgon – Gorgon Project – (Barrow Island, Australia)

Infrastructure Hero of the Year

TECON S.r.l. – Costa Concordia Wreck Removal Project – (Isola del Giglio, Grosseto, Italy)

Initiative in Information Mobility

Imarati Engineers & Consultants – IEC BIM-based Program Management – (Abu Dhabi, United Arab Emirates)

Innovation in Comprehensive BIM

Morphosis Architects – Perot Museum of Nature and Science – (Dallas, Texas, United States)

Innovation in Comprehensive BIM

Consolidated Contractors Company on Behalf of TCAJV – Midfield Terminal Building - Abu Dhabi International Airport – (Abu Dhabi, United Arab Emirates)

Innovation in Comprehensive BIM

GS Engineering & Construction – Mokpo Cable-stayed Bridge – (Mokpo, South Korea)

The Be Inspired Awards winners for 2013 are as follows:

Innovation in Asset Lifecycle Information Management

Suncor Energy Inc. (Edmonton Refinery) – Information Plant – (Edmonton, Alberta, Canada)

Innovation in Asset Performance Management

ScottishPower – ScottishPower Strategy for Asset Management and Process Safety – (United Kingdom)

Innovation in Bridges

Bloom Companies, LLC – Rawson Avenue Interchange Reconstruction – (Milwaukee, Wisconsin, United States)

Innovation in Building

Rogers Stirk Harbour + Partners – Cancer Treatment Centre for Guy's and St Thomas' Hospitals – (London, United Kingdom)

Innovation in Collaboration Using i-models

CB&I Power – AP1000 Nuclear Power Plant i-models – (Jenkinsville, South Carolina and Waynesboro, Georgia, United States)

Innovation in Construction

Intelliwave Technologies Inc. – Alberta Oil Sands – (Alberta, Canada)

Innovation in Generative Design

LAB Architecture Studio with SIADR – Wujin Council Offices – (Changzhou, Jiangsu, China)

Innovation in Geospatial Networks

EPCOR Water Services Inc. – WALRUS - Water and Land Related Utility System – (Edmonton, Alberta, Canada)

Innovation in Government

Crossrail Ltd – Managing Complexity on Crossrail – (London, United Kingdom)

Innovation in Land Development, Engineering, and Management

Foth Infrastructure & Environment, LLC – Lower Fox River, Operable Unit 1 – (Neenah, Wisconsin, United States)

Innovation in Mining and Metals

Hatch Associates Pty Ltd – Qinghai Magnesium Smelter – Dehydration Facility – (Golmud, Qinghai, China)

Innovation in Offshore Engineering

TECON S.r.l. – Costa Concordia Wreck Removal Project – (Isola del Giglio, Grosseto, Italy)

Innovation in Point-cloud Processing & Management

J.L. Patterson & Associates, Inc. – Cascade Tunnel Study – (Stevens Pass, Washington, United States)

Innovation in Power Generation

Eskom Holdings (Pty) Ltd – Kusile Power Station - Virtual 3D Plant Simulator for O&M – (Witbank, Mpumalanga, South Africa)

Innovation in Process Manufacturing

Pall India Pvt. Ltd. – Jet-pulse Blowback Filtration System (Gas Solid Separation System-GSS) – (Panipat, Haryana, India)

Innovation in Rail and Transit

Ineco – HS2 Birmingham Delta Junction – (Birmingham, United Kingdom)

Innovation in Roads

URS Corporation – Stockholm Bypass, FSK06 Akalla - Häggvik Design Contract – (Stockholm, Sweden)

Innovation in Structural Engineering

Shibanee and Kamal Architects – Bhau Institute of Innovation, Entrepreneurship and Leadership – (Pune, Maharashtra, India)

Innovation in Transportation Asset Management

Utah Transit Authority – Transit Asset Management – (Salt Lake City, Utah, United States)

Innovation in Utility Transmission and Distribution Infrastructure

China Power Construction Corporation Jiangxi Electric Power Design Institute – Duxiling 220 Kilovolt Substation – (Pingxiang, Jiangxi, China)

Innovation in Water or Wastewater Treatment Plants

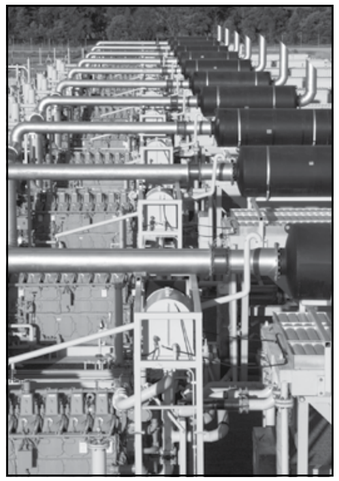
CH2M HILL – City of Las Vegas Wastewater Pollution Control Facility (WPCF) Infrastructure Replacement – (Las Vegas, Nevada, United States)

Innovation in Water, Wastewater, and Stormwater Network Modeling and Analysis

Maynilad Water Services, Inc. – Remote Leak Detection through Hydraulic Modeling – (Malabon City, Philippines)

For additional information about each of the 2013 Be Inspired Awards project winners visit :

www.bentley.com/beinspired2013winners



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Putting A Test Case For Integrity Management

Widely-publicised catastrophic failures of forged materials in deepwater applications have called into question the structural integrity of such products and focused industry attention on the need for carefully-managed 'integrity management' of key components.

Errors in material selection at the design stage, the use of incorrect heat treatment techniques and inconsistent mechanical testing regimes, often involving test pieces not taken from the actual components, can lead to product failures during operation, typically resulting in significant environmental, safety and financial costs.

With suppliers to the oil & gas and marine industries particularly appreciating the need for integrity management of deep sea components to prevent expensive failures or prolonged shutdowns, Yorkshire-based independent heat treatment and metallurgical testing specialist Keighley Laboratories is experiencing an upturn in demand for first article inspection of pre-production components, to ensure meeting operators' engineering specifications.

It is a preventative measure that the company believes could be adopted more widely, especially with the life expectancy of products extending from ten years to 25 years or more, often in extremely harsh and corrosive environments.

"Product failures bring problems that engineering companies simply don't need, wasting time, money and damaging their commercial reputations, when customers are inconvenienced," says Leonard Stott, Customer Support Manager for Keighley Labs' Technical Services division. "More than ever there is a definite requirement for proven product reliability and fitness-for-purpose, as well as a need for consistent mechanical and corrosion properties that can only be achieved by applying the correct processing and heat treatment techniques. Also, product testing procedures need to be accurate, not least the correct positioning and orientation of test sample pieces, to ensure optimum and consistent test values.

"It would be costly for suppliers to set up the necessary in-house procedures to ensure critical mistakes don't happen, so it is worthwhile sub-contracting the metallurgical testing of components to independent experts like ourselves," he adds. "We are specialists in the analysis, testing and heat treatment of metals, holding many leading quality accreditations relevant to various industry sectors, and we have the in-depth metallurgical knowledge and experience for the assessment of potential failures and the development of risk mitigation strategies."

It was the catastrophic failure of a mooring shackle in the Gulf of Mexico and a second incident involving two sockets in another mooring system, which highlighted faults in the original heat treatment process as a likely cause. A subsequent report by the US Department of the Interior's Minerals Management Service (MMS) concluded that defective heat treatment during component processing resulted in a metal unable to meet Charpy impact test requirements for material toughness and that testing parameters were either not followed or not adequate to ensure specifications were met.

The MMS recommended that operators should revise their specifications to make sure that testing and manufacturing produces a satisfactory product, which will meet future usage demands. It also commented that operators should review their requirements for both destructive and non-destructive testing of critical elements, as well as ensuring that test coupons, or pieces, are properly representative.

Indeed, it was later found that the test pieces were not samples taken from the actual product and subsequent research indicated the importance of sample positioning in achieving representative and consistent toughness values. Thus, while energy absorption in a longitudinal orientation achieved a satisfactory 70-80 joules, the same test in the transverse direction recorded a disastrously low 4 joules. It was also easier for a smaller test piece of 2" cross-section to pass the impact test, rather than a larger, more representative section.

Through a wealth of metal testing and heat treatment experience, developed over a market history dating back more than 90 years, Keighley Laboratories is perfectly placed to offer independent metallurgical testing, on a sub-contract basis.

Its long-established Test House boasts a full array of physical and mechanical testing resources, including room and sub-zero temperature assessment down to -196°C, Charpy impact test and sample preparation provisions, all the main hardness and micro-hardness testing methods, and specialist equipment for tensile and compression loading and determining other key mechanical properties. Accelerated salt spray techniques, humidity chambers, solvent/chemical resistance and other corrosion-related testing are also among its specialised facilities.

A spacious new optical suite houses advanced metallurgical microscopes complete with image capture software, a fully-equipped CNC machine shop, a highly-respected chemical analysis department and a dedicated team of NDT inspectors qualified to PCN Level 2/3, further extending Keighley Labs' in-house technical resources, establishing it as one of the best-resourced independent metallurgical testing services in the country. Added to which is its undoubted expertise in the heat treatment of metals, including expert consultancy on thermal and quenching processes and the selection of suitable materials at the design stage. The fact that all of these interrelated metallurgical capabilities are available to customers on a single site only strengthens Keighley Labs' credentials for metallurgical testing of critical components and advising on product quality issues.

Keighley Laboratories Limited, lstott@keighleylabs.co.uk

Girls come up trumps as Tradies for a day

More than 60 young women from 15 Brisbane, Australia, high schools descended on SkillsTech Australia's Acacia Ridge Training Centre to try their hands at a trade. Girls Try'aTrade is an initiative allowing students to 'have-a-go' at different trades in a safe, hands-on and dynamic environment.

Specifically, participants in last week's Try'aTrade event got their hands dirty in:

- Building and construction – painting and decorating, cabinet making, wall and floor tiling
- Manufacturing and engineering – electrical, Computer Numerical Controlled (CNC) machining, welding.

Developed collaboratively with Construction Skills Queensland and WorldSkills Australia, the day-long event also provided an opportunity for girls to gain valuable career advice from industry representatives, apprentices, trade-qualified trainers & local employers.

SkillsTech Australia's Business Manager of the Schools Liaison Unit Jennifer Mitchell said the event provided young women with valuable information and options about trade careers.

"A vocation in a technical area, especially non-traditional trades, has traditionally been male-dominated, however, a trade career can be an equally rewarding choice for women and we're seeing increasing numbers of female students which reflect this," said Ms Mitchell.

For Grade 10 Stretton State College student Peta-Jayne Wrigley, Girls Try'aTrade was like opening a window and looking into a new world.

"It's been awesome to see what's involved in different trades and to get a clearer understanding of what trade training is actually like," she said.

Over the past three years SkillsTech Australia has seen a steady increase in the number of female enrolments: from 2010 to 213 female enrolments at SkillsTech Australia increased by 227%.

WorldSkills Australia Project Manager Eric Davis said response to the event from students and teachers was overwhelmingly positive.

"WorldSkills Australia and CSQ are keen to continue working with SkillsTech Australia on programs highlighting and encouraging young women to consider career paths in non-traditional skill areas," said Mr Davis.

"They bring a higher level of discipline and focus to their work and they generally have an eye for detail that most men don't have," he said.

www.SkillsTech.TAFE.qld.gov.au

Fluke 1586A Super-DAQ Precision Temperature Scanner

Fluke 1586A Super-DAQ Precision Temperature Scanner delivers best-in-class accuracy for critical measurements

Fluke Calibration, a leader in precision calibration instrumentation and software, introduces the 1586A Super-DAQ Precision Temperature Scanner. With up to 40 analogue input channels and scan rates as fast as 10 channels per second, the Super-DAQ is ideal for applications such as thermal mapping, process sensor calibration, quality control testing, lifecycle testing, process monitoring and environmental testing common in various industries including pharmaceutical, biotechnology, food processing, aerospace and automotive.

With the flexibility of both internal and external input modules, the 1586A is designed for use on the factory floor where channel count and scan speeds are important and in the calibration laboratory where accuracy and quick input connections are required.

The 1586A can measure thermocouples, platinum resistance thermometers (PRTs), thermistors, dc current, dc voltage and resistance. It offers best-in-class temperature measurement accuracy of plus-or-minus 0.005 degrees Celsius for PRTs, 0.5 degrees Celsius for thermocouples, and 0.002 degrees Celsius for thermistors.

www.fluke.com.au

Thermal Imaging Shows the Way to a Safer Sydney Harbour

Harbour City Ferries has developed as a high-reliability organisation concerned with the safety of its staff, vessels and other users of Sydney Harbour. Now its entire fleet are equipped with FLIR M320L thermal imaging cameras to further improve safety on the waters of Sydney.

Sydney's ferries have been servicing Sydney Harbour for more than 135 years. Harbour City Ferries operate approximately 175,000 services, transporting nearly 15 million people 1.3 million kilometers across the busy and scenically beautiful Sydney Harbour and the Parramatta River each year. This bustling harbour is not only a thriving port, catering to an unmatched array of commercial shipping and recreational boating; it is also a "circuit" to recreational paddlers and kayakers. With all this activity, and Harbour City Ferries' strategic focus on safety as its first priority, it was decided to install thermal imaging cameras on board the entire fleet of 28 vessels, six of which are double-enders, so 34 FLIR M320L cameras were purchased in total.

A dangerous place

In a crowded waterway such as Sydney Harbour there are countless opportunities for accidents to occur. Thankfully, with the installation of FLIR thermal imaging cameras on its fleet, Harbour City Ferries have made the harbour a safer place than in days gone by when only radar systems were fitted.

The Sydney Harbour Bridge casts a radar shadow underneath it that limits the utility of radar in the area. The usefulness of radar is also adversely affected if the target vessel is small and not constructed of radar-reflective materials or does not have a radar reflector installed on it. Down-lighting from the Harbour Bridge, and background lighting and reflections off the water can also make spotting some vessels difficult.

"Although thermal imaging cameras produce clear images in total darkness, we are also operating during the twilight hours of the day, when some sunlight or moonlight is present. Also during docking operations there is some light from the marina present. For these situations we wanted a lowlight camera as well," stated Glenn Young, Harbour City Ferries General Manager Operations and Asset Management

FLIR M320L: the perfect solution

"When we understood that Sydney Ferries wanted to have a combination of a thermal imaging camera and a lowlight camera, we decided to demonstrate the FLIR M320L", explains Paul Garske.

Installation of the FLIR M320L commenced in 2009 along with other Navaids equipment, supplied, installed and supported by Electrotech Australia. "The FLIR thermal imaging cameras are navigational aids for the masters and crew of the ferries to assist during times of poor visibility, such as fog, rain, glare, low light and at night," said Stephen Penny, Project Manager of Electrotech. The systems are also used for incident recording in conjunction with GPS, time stamp and speed overlay; all of which were installed by Electrotech.

Excellent feedback from masters

"The feedback that we are receiving from masters on the FLIR M320L has been great," continues Mr Young. "They all report that the M320L helps them to get a better understanding of what is happening around their vessel. They find it extremely easy to use and the joystick allows the master to operate all the features of the M320L such as pan/tilt or switching from daylight to thermal image. The joystick is on each bridge console, as close to the wheel as possible, so all features are right at the master's fingertips.

"Thanks to the crisp images the M320L is producing," continues Mr Young, "the masters' situational awareness has improved drastically and they have more time to anticipate and react to what is happening around their vessel. During twilight hours, or when some light is present, they can use the lowlight camera. Once it is getting too dark they just switch to the thermal imaging camera and maintain a clear overview of the situation."

"At Harbour City Ferries, we are convinced that thermal imaging cameras are a great tool to increase safety on board any vessel." concludes Mr Young.

Disclaimer: Images for illustrative purposes only and may not be representative of the actual resolution of the camera shown. Technical specifications subject to change without notice.

www.flir.com info@flir.com.au

Intergraph® has released Intergraph Smart™ 3D 2014

Intergraph® has released Intergraph Smart™ 3D 2014, a new single solution created from the consolidation of SmartPlant® 3D, SmartMarine® 3D and SmartPlant 3D Materials Handling Edition. Smart 3D 2014 builds upon Intergraph's Smart 3D technology architecture to increase quality, interoperability and productivity for clients in the plant, offshore, shipbuilding, metals, mining and bulk material handing industries to have even greater workforce flexibility.

Smart 3D is the world's first and only next-generation 3D design solution specifically tailored for plant, offshore, shipbuilding metals, mining and bulk material handling industries, employing a breakthrough engineering approach that leverages rules-based concurrent design, relationships and automation. It is the most advanced and productive 3D design solution that effectively enables optimized design, increasing quality, interoperability and productivity, while shortening project schedules.

Smart 3D combines the functionality for marine/offshore projects and materials handling with those of onshore plant design. It features numerous unique capabilities and enhancements requested by users of Intergraph's Smart 3D technology, including:

- Model Data Reuse (MDR) functionality ensures efficient re-use never before possible in other 3D CAD applications. Users can reuse front-end engineering design (FEED) or old designs with different catalogs and specifications, by leveraging MDR's unique rule re-use, tag re-naming and specification transformation. Orthographic drawings are automatically copied and updated for unprecedented savings.
- 64-bit clash detection and further automated drawing generation for higher performance than ever before.
- Enhanced 3D interoperability capabilities enable the use of 3D data from multiple third-party CAD systems in conjunction with native Smart 3D models. Smart 3D is the only system offering interoperability with both graphics and data attributes of third-party CAD models, making it ideally suited to brownfield and joint-venture projects. Through integration with SmartPlant Interop Publisher, Smart 3D extends the number of supported 3D formats, providing a richer, centrally-managed 3D ecosystem.
- Extended 3D translation capabilities enable the use of a single design solution for engineering contractors who are required to deliver in Smart 3D or PDMS formats, including iterative updates. EPCs who take advantage of this feature will cut costs by only supporting one 3D solution.

Many of Intergraph's most significant and innovative clients, as well as participants in Intergraph's Agile software development process, have been involved in beta testing of Intergraph Smart 3D.

"As a participant in the beta testing program, Technip was especially pleased with the installation, configuration and administration improvements in the 2014 release," said Technip Smart 3D Business Product Manager Didier Tison. "We were able to easily bring forward projects built on the 2009.1 release. The improved configuration for extraction of deliverables is significantly faster and the 64-bit processing capabilities allow large drawings to benefit from increased memory availability. It's also much easier to configure and run."

"Technip designers will definitely take advantage of 2014's improvements around jacketed pipe design and deliverables extraction. One of the reasons Technip adopted Smart 3D was because of its integration with Intergraph's 2D design tools. Smart 3D 2014's Design Basis Viewer provides an easier way to compare and update the Smart 3D model with the data in SmartPlant P&ID, SmartPlant Instrumentation and SmartPlant Electrical," said Thomas Kerjouan, Technip France Smart 3D administrator.

Learn more about the numerous benefits of Intergraph Smart 3D by viewing a video at www.intergraph.com/go/Smart_3D_Learn_More_Video.

For more information about Smart 3D, visit www.intergraph.com/assets/pdf/Smart_3D_Product_Sheet.pdf.

Fluke 2638A Hydra Series III Data Acquisition System provides best-in-class thermocouple accuracy in a portable system

New DAQ system expands to support up to 66 channels of analogue input and large, multichannel data collection systems

November 6, 2013 – Fluke Corporation introduces the Fluke® 2638A Hydra Series III, the latest addition to the Hydra line of Data Acquisition Systems / Digital Multimeters.

The Fluke 2638A features a full-colour display with an easy-to-use menu system, DC measurement accuracy of 0.0024 per cent, 6.5 digit DMM mode and CAT II safety ratings. This makes it a truly industrial grade, precision data acquisition (DAQ) system.

The 2638A incorporates the Fluke Universal Input Connector that supports 15 common thermocouple types and delivers thermocouple accuracy of 0.5 degrees Celsius. The inexpensive, plug-in Universal Input Connector has 22 channels of differential analogue input (expandable to 66 channels) for wiring multi-channel systems. Once a system is wired, the connector can be disconnected and the 2638A moved and connected to another input connector, eliminating the need to disconnect and rewire test setups.

Selectable measurement input types include dc voltage, ac voltage, resistance, thermocouple, RTD, thermistor, frequency, and dc and ac current.

The Hydra Series III has 20 on-board math channels with alarm settings for even complex math calculations that record results to your data file during each scan. It can chart real-time data of up to four channels at once with a history mode that allows scrolling through previously collected data within the scan file without a PC or expensive charting programs. Optional application software is available for connecting several units together for larger system configuration of up to 2000 channels.

The Hydra Series III has on-board memory for storing more than 57,000 data records and configuration files, as well as a USB port to collect and store large files directly to a USB drive. The USB and LAN interfaces allow easy connection to PCs and networks.

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Equipment, Services & People - News

High expectations: Employers making higher demands on workers

Employers are demanding more of workers than ever before, with 84% of Australians saying organisations are making higher demands on their skills than five years ago, according to a Randstad Workmonitor.

Globally, employers in the Asia Pacific region are among the most demanding with 94% of Chinese workers, 93% of Malaysian and 85% of workers in Hong Kong saying their bosses demand more now than five years ago.

The Randstad Workmonitor, commissioned by recruitment & HR services specialists, Randstad, surveys over 13,000 people across 32 countries each quarter, also shows that almost three quarters (73%) of Australian workers expect their job requirements to become even more demanding in the future, with over a quarter (28%) concerned this increase in demand will leave them unable to fulfil employer expectations.

Despite this, there is a significant disconnect around how workers will meet these changing demands.

While two thirds of Australians say their job requirements have changed significantly over the past five years, 21% believe they don't have any responsibility in ensuring their skills correspond with these new demands, while 89% believe the responsibility lays at their employers' feet.

These figures are dramatically different from the rest of the Asia Pacific region, where employees take far greater responsibility keeping up with the changing workforce. Eighty-nine per cent of workers in Singapore, 94% of Malaysians and 93% of Hong Kong employees all believe they share responsibility with their employer for improving their professional skills.

Steve Shepherd, Group Director of Randstad, believes a highly talented workforce is vital to the continued success of the Australian economy.

"If Australia is going to maintain its position as one of the most successful economies in the region, it's important that businesses and employees alike place a premium on developing skills. This needs to be done at all levels of an organisation, to keep local businesses at the forefront of global industries. As an industry professional, developing strong skillsets will help you stand out from others in your field.

"Ultimately, the responsibility rests with both the individual and the employer. All businesses need to actively invest in training and up-skilling their employees, and Australians should feel more encouraged to seek out opportunities to do so from their employer," says Shepherd.

Interestingly, two areas which stand out for many organisations are digital literacy and social skills, with 87% saying digital skills have become even more vital over the past five years and 66% saying employers are placing a greater importance on their social skill set.

Steve Shepherd believes this shows the wide range of skills workers should be looking to improve in order to remain attractive in the future job market.

"There are a range of traits and skills employers will increasingly find valuable. People are expected to be far more versatile and knowledgeable in a range of areas than in previous generations. The trick for people is to identify areas where they haven't had previous training, and skills which are important in their industry or business in the years ahead.

"Workers should feel open to discussing this with their managers. Becoming proficient in areas which are vital to a business is not only a good way to prove your value, but also become in-demand in the wider job market.

"Businesses should also welcome the opportunity to develop their workforce in a range of areas, to harness their passions and interests. Finding areas which are useful to both the organisation and the employee is often the key to future growth and higher performance and productivity," says Shepherd.

www.randstad.com.au

CAPS manufactures skid-mounted compressor for global landmark project

To support a major natural gas project overseas, the manufacturing division of Compressed Air and Power Solutions (CAPS) Australia has manufactured and shipped a large packaged skid to help provide energy to thousands of homes and businesses across Pakistan.

The compressor package was produced for the Makori GPF project in Pakistan. A packaged skid produced by CAPS is designed to be a self-contained system that can be delivered on site and ready to operate once all the external connections are secured.

The design, construction, testing and delivery of the project was a collaboration between the CAPS manufacturing teams in Perth and the client. CAPS — the largest Australian-owned compressed air company in Australia — achieved excellent project management and build quality to supply a world class solution to an important client.

The skid, with a length of nine metres and width of 2.2 metres, consisted of two Ingersoll Rand oil-free rotary screw compressors and two desiccant dryers. These major compressed air components were mounted with all associated filtration and ancillary equipment. The whole package delivered to the end customer had an overall mass of more than 10 tonnes. www.capsaust.com.au

RadarEye makes the difference at Sibelco

Orlaco's RadarEye an advanced camera and monitor system that feeds constant, real-time vision and detection information of the working area to the vehicle operator. Since its introduction, the RadarEye system has been helping to improve the safety and efficiency of industrial vehicles for numerous companies. One such company is Sibelco Benelux.

Impressed at first glance
Sibelco extracts and refines various types of sand and minerals, mostly high quality silica sand for industrial use. Hans Ophelders first noticed RadarEye during a trade event. "I was walking around the event floor when Orlaco's booth, and their RadarEye vision system, caught my attention," explains Ophelders. At that time only one wheel loader at our new plant in Maasmechelen was equipped with a vision testing system of another brand, which consisted of two ultrasonic sensors and three cameras. "That system was good in its own right, but it had difficulty giving the loader operators a clear picture through the dusty, sandy environment we work in."

RadarEye rises to the occasion
After an informative conversation with the Orlaco sales representative, Mr. Ophelders and Mr. Stienen arranged for a trial run of the RadarEye system. An Orlaco service team went to the Sibelco plant in Maasmechelen (Belgium) and installed RadarEye on one of their wheel loaders. In order to fairly evaluate the two systems, the other wheel loader used the ultrasonic system. The operators were able to compare the performance of the two systems during a regular working day. Ophelders: "RadarEye came out on top because of its ease of use, clear on board screen reception, and ability to "see" clearly through the sand and dust. At this moment we are gradually installing RadarEye systems onto all our wheel loader trucks throughout our Benelux locations, because it seems to make a significant difference to our Loader operators."

Additional job satisfaction
One such operator is Jos Denneman. Jos has been operating wheel loaders for Sibelco for 25 years now, and is very satisfied working with the Orlaco RadarEye vision system. "The RadarEye system is a solid, no-nonsense vision system that helps me get the job done. It makes my work in the cab more comfortable because I don't have to twist and turn to check that I'm positioning the truck accurately. The real-time feedback I get on the large dashboard display is very sharp, and the built-in warning signals let me know what's behind me when I'm backing up, and when to stop. All in all, it's just a safer and more efficient way to work."

Keeping safety in check
In a busy work environment like Sibelco, there are any number of vehicles and people moving around the dusty terrain throughout any given day. That is why it was agreed that Orlaco technicians would come to various Sibelco sites and perform yearly safety checks on each and every RadarEye system. Preventive Control Checks (PCC) involve an entire check of the active vision systems to ensure ongoing optimum use. "After all," says Ophelders, "the Sibelco machines have to meet yearly quality and safety inspections, and checks on this important safety tool should be included."

Thinking with the customer
Of course, every innovation needs to fit the specific customer. Orlaco does their best to ensure that their customers are satisfied with the Orlaco products. "A few weeks after working with the RadarEye vision system, the operators mentioned that the system's warning signals weren't optimal. With all the bells, whistles, and moving parts to contend with in a wheel loader cab, RadarEye's warning beep was lost in the shuffle," says Ophelders. "We went to Orlaco with this and they got back to us quickly with a tailor made solution: a large, silent STOP icon now flashes on the screen as a warning, catching the eye of the operators and warning them to stop or make an adjustment. It's this kind of attentive service that makes all of us at Sibelco glad we chose to install the Orlaco RadarEye vision systems!"

www.orlaco.com

Articles, news and case studies relating to the management, procurement and use of spare parts & materials in the world of asset management & maintenance.

To contribute an Article or News to a future edition contact Phill@PhillipSlater.com Phillip Slater - Editor SPP & M

There are 2 Stores/Parts Articles in this section PLUS a 3rd Stores/Parts article that is downloadable from the Technical Reports & Research page of this issue Page 59.

Spare Parts Inventory: An Exercise in Risk Management

Part 2

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In part 1 of this article (Nov 2013 AMMJ) we explored the relationship between spare parts inventory management and risk management. We explored the reasons for holding inventory, the consequence of breakdowns and the worked through a process for evaluating a process for deciding on inventory holdings based on risk assessment. In part 2 we now take the ideas discussed in part 1 and explore the impact of your maintenance policy on your spare parts inventory and risk exposure.

Risk Management Options

In all cases of risk management there are four options for the management of the risk. As you evaluate each risk, you need to then adopt a management strategy based on the chosen option adopted for that risk or class of risks. The risk management options are presented here in the order in which they should be considered.

1. Avoid the risk -

One way to avoid risk is to re-design the work. In many circumstances, this might involve reengineering, choosing long lived assets, or even replacing the asset. The best way to avoid the risk of an iatrogenic failure (failure caused by the mechanic or electrician) is to design the system to not break down! Of course that is tough but improvements in reliability that are based on equipment design are made every day. If you can't eliminate the risk the next step is to mitigate it.

2. Mitigate the risk -

Mitigation involves reducing the probability of the risk happening (using existing technology instead of new technology) or reducing the consequence of the risk or some combination of both. For example, in the aircraft industry the risk of incorrect repairs has both safety and economic consequences. The industry mitigates this risk through rigorous repair procedures, certification of operators and mechanics, and close-in inspection. While these actions mitigate the risk they do not eliminate it. In an industrial situation, one way to minimize the consequence of a breakdown risk is to have backup systems in place.

3. Insure the risk -

Insurance is a form of risk mitigation in that it minimizes the consequence of the risk. It is included here as a separate option because the key is to shift the financial impact of the risk from you to the insurer. Here are some common types of insurance:

a. Fire insurance for fires
b. Liability insurance for accidents to visitors
c. Workmen's compensation insurance for employee injuries
d. Business continuity insurance to cover catastrophic interruptions to business activity.

4. Accept the risk -

You decide that the risk probability or consequence is sufficiently low that you can handle it without help or additional systems. Sometimes this is referred to as 'self insurance'. An example of this is companies with large vehicle fleets that don't take out external insurance. They accept that they will need to repair/ replace vehicles involved in an accident on the basis that in the long run this is less expensive (because of the large fleet) than the insurance.

The Impact of Your Maintenance Policy

It is important to understand that the chosen maintenance policy for different classes of assets does drive parts usage. The maintenance policy is the strategy chosen to deal with the service and repair requirements of the various assets. Strategy's might include using a contractor to take care of it completely (such as your elevators and HVAC) or where you just replace but do not attempt rebuilds in-house (such as transmissions in a heavy duty truck shop) or where you do all minor work and the vendor/contractor gets any heavy work (car rental company).
Each maintenance policy determines the need to carry the parts in your own inventory (assuming that the previous risk assessment indicated that you should stock parts). Table 4 shows some examples.

Table 4: The Parts Stocking Effect of Different Maintenance Strategies

Description of strategy	Example	Effect on parts stocking
Contractor takes care of asset completely	Fire safety, escalators, complex and sensitive equipment like turbines, generators	No parts, few parts[1]
Replace whole components but do not attempt repair or rebuilds	Circuit boards inside machines, truck repair, gear boxes, motors	No parts, just stock completed units or make deal with rebuilder to supply requirements within 24 hours [2]
All minor work done in-house and the vendor/contractor gets any heavy work	Car rental, satellite facilities where there is not a full local crew.	Minor wear parts like filters, belts, hoses, etc.
All work done in-house	Typical factory maintenance department on important assets	Lots of stock

Notes:

(1) You might hold some parts as an insurance policy against the contractor making a mistake but if they provide all service (such as a contract with Siemens on a Turbine) you might not have the expertise to choose the right parts. Part of your contract is for Siemens to stock certain parts in your location or nearby.

(2) While it is true that in a factory there are plenty of motors, cylinders, gear boxes, the number of SKUs (Stock Keeping Unit) is smaller if we stock just the finished units rather than the parts to rebuild or repair all those items.

Eliminate the Condition and You Eliminate The Risk

It is good practice (and required by law in the US) to inspect slings, chains, and other lifting gear every day. This practice minimizes the probability of a failure. Another practice is encompassed by good rigging techniques that examine the center of gravity, weight, and material being lifted, and rigs each lift properly. A third practice is the clearing of lift paths so that if the lifting gear does fail, no one will get hurt.

Each of these practices mitigates a specific element of the overall the risk but doesn't eliminate it. With the lowered level of risk, the process owner can, in good conscience, accept the small probability of a failure. If the job can be done efficiently without lifts at all then the risk has been eliminated.

The rule of risk management is; if it is possible to eliminate the condition then the related risk is also eliminated. This approach applies particularly to safety and environmental hazards. When you eliminate a risk, of course, be sure you are not introducing a risk that is worse.

What if the consequences of the part falling are truly catastrophic? What if the lift involves a giant tank of poisonous gas or a nuclear core? I'll bet that the lift planner will go through additional steps to lower the likelihood of failure 100 more times!

Emotionally Driven Inventory is Not the Solution

There is such a thing as too much risk coverage. For example, you can have insurance that covers all medical costs from the first dollar. People might congratulate you on your choice but in fact this is over-insurance because it is always cheaper to cover the small risks yourself (by not insuring them) than it is to cover everything. This is sometimes referred to as an excess on your insurance and is an example of 'self insurance'.

With spare parts inventory, having every single part in adequate quantities to ensure no possible stock outs ever is overly expensive, takes up too much room, and is inefficient.

To have the right amount of stock we must understand the consequences of not having the part but also the probability that we'll need it. As mentioned previously the probability of the requirement for a second spare is limited to the probability of a failure during the lead time in which you can restock the first spare, not the probability of failure during the remaining life of the equipment.

Understanding this simple step of logic could save your company from holding thousands (or even millions) of dollars in unnecessary spare parts.

Managing Breakdown Risk

Since a breakdown can disable a whole plant or other asset we need tools to detect when they are going to fail (to give us the most time possible) and techniques to extend the useful life of the asset.

It turns out we already have some powerful tools to manage breakdown risk.

Our first line of defense is our quality operators and drivers. These people are the DEW line (Distant Early Warning line was a cold war line of radar stations that could detect Russian missiles coming over the pole) for your equipment. Properly trained and motivated they can report abnormal sounds, vibrations and operations. They also can perform essential safety checks and basic maintenance to insure long life of equipment.

Our second line of defense is our quality maintenance and PM system. By doing basic maintenance (such as TLC- Tighten, Lubricate, Clean) we know the asset will last longer. Often we can make an asset last long enough for our needs. The skilled mechanics have dozens of years of experience looking at equipment and catching subtle signs of impending failures. Their inspections tell us what is happening and more importantly, what will happen to the asset.

The third line of defense is a well-designed PdM (Predictive Maintenance) system. This includes all kinds of instruments, gauges, sensors, computers and other high tech gear that allow us to see inside the equipment. The computers can talk to us about what is happening, the scanners can see heat, hear high frequency squealing or feel subtle vibration.

The fourth line of defense is the skills of the mechanics coupled with the right tools and the spare parts.

Think of Your Inventory as a Kind of Insurance Policy

When you look at your spare parts inventory imagine that you are looking at shelves of very specific insurance policies. Each inventory item that you purchase is a way of mitigating the consequence of failure of the part in operation. Now ask yourself: How often your boss comes to your office and insist that you had better use 10% of that insurance. Of course that never happens.

If you successfully perform risk management on insurance policies you can achieve two outcomes:

1. The least cost for insurance by having as little as is reasonably possible, and
2. Minimal consequences for the organization should any risks that the insurance covers come to pass.

With insurance you want to cover only what you need, and can afford, and nothing more. It's the same with your spare parts inventories.

Of course, with your spare parts it is important to cover the risk but it is also important to be able to justify everything on the shelf – holding only what you need, and can justify, and nothing more. That is the key to effective spare parts risk management.

About the Authors

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Phillip Slater specializes in Materials and Spare Parts Management. He is the founder of the website SparePartsKnowHow.com, and the author of 8 books, including Smart Inventory Solutions and The Optimization Trap.

For a complimentary copy of the ebook 5 Myths of Inventory Reduction please visit

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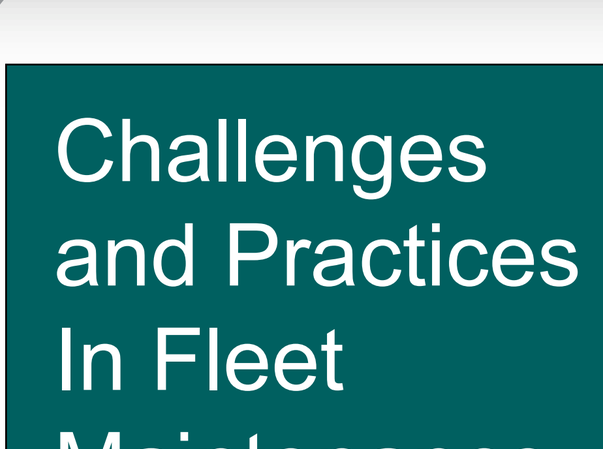
Challenges and Practices In Fleet Maintenance Spare Parts Management



Amelia Patricia Murrin, D.B.A.

Operating supplies and spare parts comprise a significant investment by fleet and other maintenance organizations. Spare parts differ from other inventoried items, such as raw materials or finished goods; these differences include intermittent demand, a wide mix of items, specificity of usage, and, in some cases, high unit cost.

Maintenance organizations routinely experience difficulties when balancing spare parts inventory investment with demand for parts and defining the most cost and service effective inventory policy for spares is an often-cited challenge.

In 2012, Patricia Murrin initiated a doctoral research project while a student at The National Graduate School of Quality Management, Massachusetts, USA. This project focused on developing a collaborative approach to the spare parts planning process.

The first phase of the project surveyed members of the North American based NAFA Fleet Management Association, an organization primarily of automotive fleet management professionals. Survey questions related to challenges and practices in spare parts planning. To supplement learnings from the survey, ten in-depth interviews were conducted with fleet and non-fleet spare parts or fleet managers. Additionally, a call for collaborative planning best practices from relevant special interest groups (using the LinkedIn® internet site) produced insightful responses and more interviews. A portion of the survey research is described in this article.

Of approximately 400 spare parts planning practitioners within NAFA's membership, 61 organizations responded to the survey in December, 2012; 41% of these organizations managed 1001 to 5000 unique part numbers/stock keeping units (Figure 1).

Challenges Faced by Parts Managers:

Fleet maintenance parts personnel stated their challenges as:

- aging fleet units and availability of parts,
- forecasting the purchasing of new vehicles and vehicle retirement (the changing fleet mix),
- avoiding obsolete inventory,
- balancing inventory investment and stock-out risk;
- low level, intermittent demand for some parts;
- availability of skilled resources (people) to manage inventory,
- lead times for parts,
- the government tendering process, and
- how to organize and classify parts.

Many of these issues are faced by parts planners in other maintenance environments as well, although the changing fleet mix (and, therefore, the risk of part obsolescence) is one that may be unique to the fleet maintenance industry.

Figure 1. Number of unique parts managed by surveyed organizations

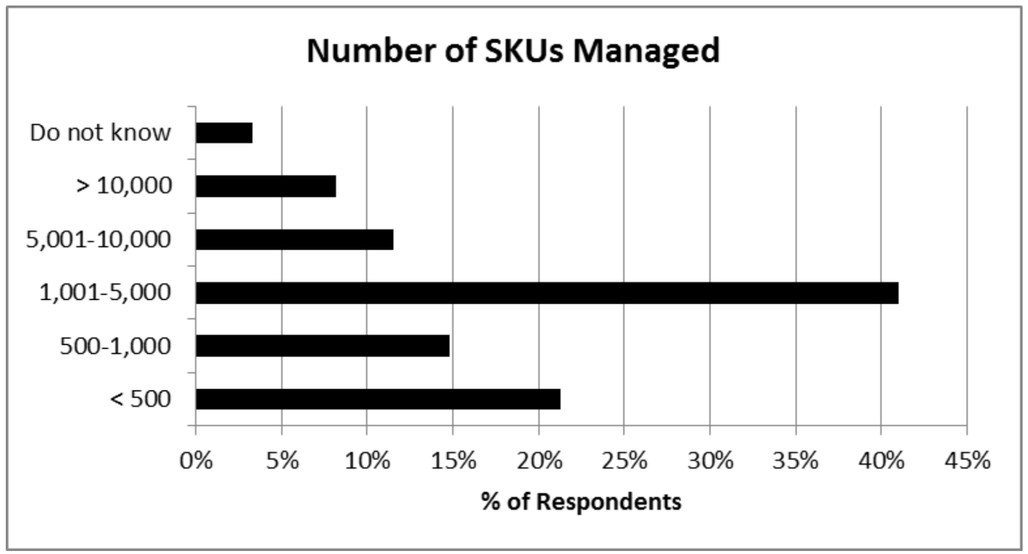


Figure 2. Factors considered in parts classification

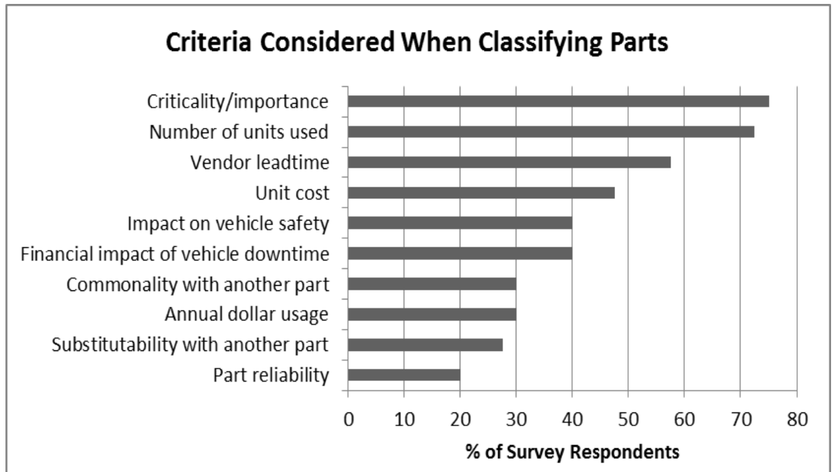
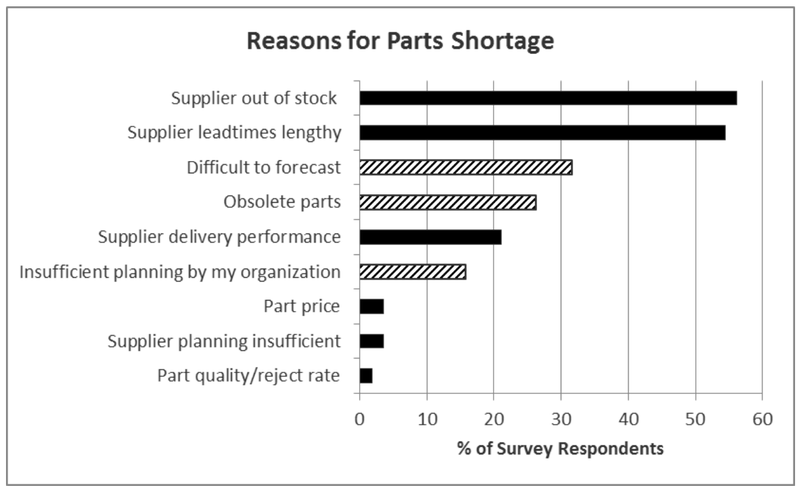


Figure 3. Reasons for spare parts shortages



Stocking Policies and Parts Classification:

Eighty-five percent of survey respondents reported using stocking policies such as min/max for all or specific parts. Fifty percent classified parts into groups based on one or more criteria, and 71% of those who classified parts used these classes as the basis for stocking policies. Criticality and parts usage rate were the dominant classification criteria (Figure 2).

Factors considered in defining criticality were primarily cost or service implications of equipment downtime, high usage, lead times, and impact on vehicle safety, in that order. It is surprising that 50% of organizations did not classify their parts; classification is a best practice long used to prioritize procurement & stocking actions such as stock, non-stock, quantities to stock, when to purchase, etc.

Other researchers feel that an obstacle in classifying spares is the lack of an easy-to-use method to combine multiple criteria. In addition, the appropriate criteria may differ with the type and focus of the maintenance organization.

Parts Accuracy and Availability:

Fifty-three percent of respondents reported inventory accuracy as over 95%, with 23% reporting 80-95% accuracy. Thirty percent reported a parts fill rate (the part is available in inventory when needed) of over 95%. However, 38% percent of respondents do not measure inventory performance, such as fill rates or turns. Of those that did, the most commonly cited were inventory turns, fill rate, on-time work order completion and dollar investment, in that order.

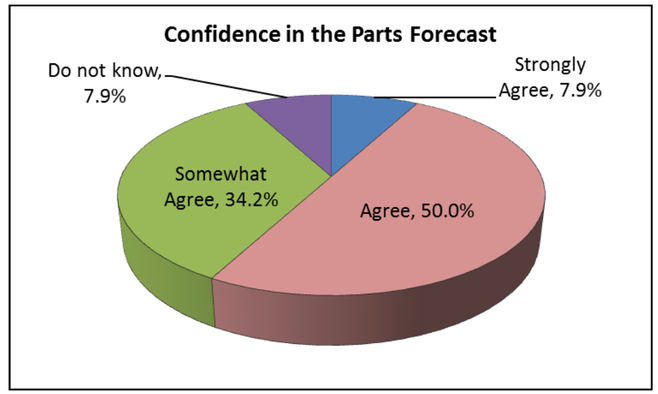
Eighty-seven percent indicated that they rarely or never run out of spare parts in spite of noted supplier issues such as lead times, stock-outs, and delivery performance. On the other hand, only 50% of respondents acknowledged knowing and documenting their supplier lead times.

As Figure 3 shows, respondents cited multiple reasons for parts shortage, with most causes attributed to suppliers (note the solid bars in this chart). This finding is revealing, suggesting the need for a stronger and more collaborative dialog with suppliers.

Forecasting Parts Demand:

Historical parts usage is the main data considered, followed by seasonal effects on equipment, upcoming changes in the mix of vehicles in the fleet, age of equipment, and several other factors. Seventy-eight percent of organizations reported using judgment calls either alone or in combination with forecasting software or spreadsheet analysis. Forty-three percent used spreadsheet analysis and/or forecasting software and 24% reported their forecast accuracy as over 90%. As Figure 4 shows, about 58% reported a reasonable degree of confidence in the forecast.

Figure 4. Confidence in the spare parts forecast



Purchasing Practices:

Respondents were about evenly split among the three approaches to purchasing: centralized, decentralized, or a combination of the two. Organizations often used multiple purchasing practices.

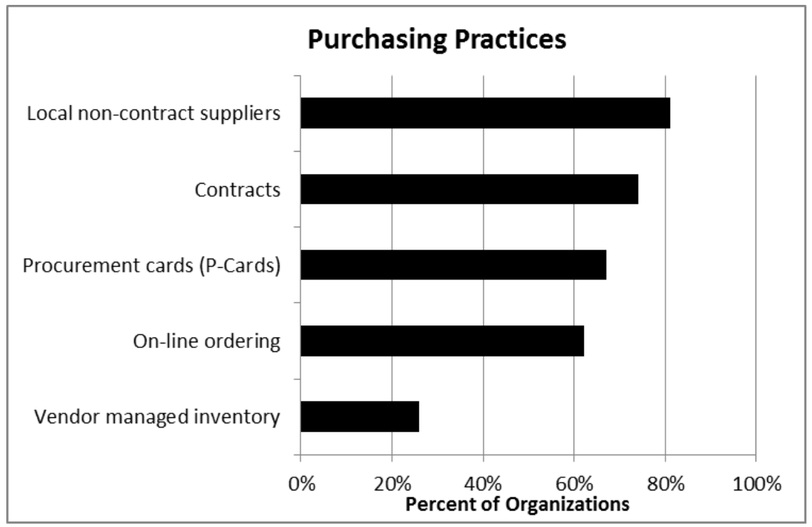
Figure 5 shows that specific practices included contracts (74% reported the use of contracts), local suppliers, procurement P-cards, on-line ordering, and vendor-managed inventory. Parts managers used contracts primarily for high usage parts, followed by critical parts and high cost parts.

Recommended Practices:

Respondents shared a number of practices that positively affected their parts management:

- Knowledgeable and skilled parts personnel.
- Improve forecasting through employee input, knowledge of organizational needs, usage history, and seasonal considerations.
- Proactive parts purchase for newly acquired vehicles.
- Weekly meetings with parts providers.
- Parts consignment agreements.
- Centralized or combination centralized/ decentralized inventory.
- Long-term outline agreements with major suppliers.
- Inventory reporting that shows turn rate, stock out conditions, parts above and below minimum quantity, inventory value of parts ordered and received.
- Maximize vehicle readiness by holding a minimum of normal service parts locally at each maintenance facility; critical parts are maintained in smaller quantities at each facility if readily available from local sources; if long lead times or availability is an issue, hold higher quantities.
- All SKU's are bar-coded at the time received and scanned at time of usage.
- Spot-check & count parts bins on a regular basis.

Figure 5. Purchasing practices reported by survey respondents



Conclusions:

Survey results for fleet maintenance organizations supported past research describing the challenges in spare parts management, with these major themes reinforced:

1. Availability of spare parts for maintenance activities is impacted by the ability to predict requirements (particularly with a changing fleet mix) as well as supplier/vendor delivery performance. Sophistication in parts forecasting ranges from computer generated to manual judgment calls.

2. Parts classification plays a key role in setting stocking policies. There is no single approach to classifying spare parts inventory. A combination of parts attributes may be used, including usage, criticality, lead-time, and part cost.

3. Inventory stocking and purchasing policies depend on the particular attributes of spare parts as well as the specific maintenance environment and strategy (e.g. scheduled, condition-based, or breakdown maintenance strategies).

4. The min/max approach for each SKU is the most common approach for triggering purchasing decisions.

5. Supplier reliability is most often cited as the reason for spare parts shortage, with lesser fault on the parts organization itself. It is likely that more effective collaborative planning and information sharing would reduce shortages.

6. Underlying management and support processes are critical to the success of collaborative spare parts demand and supply planning. These processes, supported with policies and procedures, provide essential governance for planning and operational processes.

7. Last but not least, in the words of one fleet manager 'Keep it Simple'. Simple planning and inventory optimization techniques can be very effective.

About the Author

Dr. Amelia Patricia Murrin is a supply chain and process improvement consultan based in Illinois, USA. She guides companies towards process excellence and has worked with diverse industries within the USA and beyond. Prior to consulting she held positions in demand forecasting, inventory management, customer service, sales and operations planning, supplier quality assurance, and information systems. Her doctorate in business administration (D.B.A.) focused on developing a collaborative process model for spare parts planning. Dr. Murrin can be contacted at her email address: apmurrin@charter.net

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